TECHNICAL SPECIFICATIONS

HEAVY DUTY

FORTY-FOOT ELECTRIC

LOW FLOOR TRANSIT BUSES

Contents

TECHNICAL SPECIFICATIONS

GENERAL

TS 1. Scope

Technical specifications define the requirements for furnishing Heavy Duty, Forty Foot (40') Battery-Electric Low Floor Transit Buses and furnishing, installing, and maintaining charging infrastructure (depot-based charging equipment) for Miami Dade County Department of Transportation and Public Works (DTPW) at three locations. Installation of the charging equipment and electrical infrastructure shall be the responsibility of the Contractor, including any modifications to the existing facilities. The buses will be for use in both general service on urban arterial streets and suburban express service. Buses shall have a minimum expected life of twelve (12) years or 500,000 miles, whichever comes first, and are intended for the widest possible spectrum of passengers, including children, adults, the elderly and people with disabilities.

DTPW expectation is to purchase buses that are distinguished in appearance, easily maneuverable in normal and heavy traffic, and reliable. The bus exterior shall appear progressive and modern. These Technical Specifications are not intended to dictate any specific design but rather to indicate the type of transit bus and equipment desired by DTPW and certain standards of bus performance which must be achieved. The buses are to be of durable, heavy-duty construction with an expected minimum life of twelve years/500,000miles. The basic structure of the bus including major suspension components shall be designed to last the life of the bus without major overhaul or replacement. The bus must be FTA fundable on no less than a twelve-year cycle. These buses shall meet DTPW's needs for a heavy duty transit bus and are intended for the widest possible spectrum of passengers, including children, adults, the elderly, and persons with disabilities.

The quantity of vehicles and parts purchased will be contingent upon the unit cost per vehicle and the total funds programmed for this purchase.

TS 2. Definitions

Alternative. An alternative specification condition to the default bus configuration. The Agency may define alternatives to the default configuration to satisfy local operating requirements. Alternatives for the default configuration will be clearly identified.

Ambient Temperature. The temperature of the surrounding air. For testing purposes, ambient temperature must be between 16 °C (50 °F) and 38 °C (100 °F).

Analog Signals. A continuously variable signal that is solely dependent upon magnitude to express information content.

> **NOTE:** Analog signals are used to represent the state of variable devices such as rheostats, potentiometers, temperature probes, etc.

Audible Discrete Frequency. An audible discrete frequency is determined to exist if the sound power level in any 1/3-octave band exceeds the average of the sound power levels of the two adjacent 1/3-octave bands by 4 decibels (dB) or more.

Battery Compartment. Low-voltage energy storage, i.e. 12/24 VDC batteries.

Battery Management System (BMS). Monitors energy, as well as temperature, cell or module voltages, and total pack voltage. The BMS adjusts the control strategy algorithms to maintain the batteries at uniform state of charge and optimal temperatures.

Braking Resistor. Device that converts electrical energy into heat, typically used as a retarder to supplement or replace the regenerative braking.

Capacity (electrical energy storage device). Two levels of capacity shall be defined, gross and useable. Gross Capacity shall be the capacity energy (kWh) of the entire battery pack and shall include usable, unusable, and/or reserve capacity energy. Useable Capacity shall be the capacity energy between the design operating range within the battery management system for normal operation.

Cells. Individual components (i.e., battery or capacitor cells).

Charger. The equipment required to convert Alternating Current (AC) to Direct Current (DC), for the purpose of charging the battery and/or operating vehicle electrical systems while connected. The Charger may be on-board the vehicle or off-board the vehicle. Off- board Chargers may be built as part of the charging station.

Charging Interface. The equipment and/or coupler used to create a connection between the charging equipment and the vehicle for the purpose of recharging a vehicle's batteries.

Charging Equipment. The equipment that encompass all the components needed to convert, control, and transfer electricity from the grid to the vehicle for purpose of charging batteries and may include chargers, controllers, couplers, transformers, ventilation, etc.

Charging Station. Location that houses the charging equipment that is connected to a utility's high voltage service, to provide electricity to a vehicle's battery system through a charging interface.

Class of Failures. Classes of failures are described below.

Class 1: Physical Safety. A failure that could lead directly to passenger or operator injury or represents a severe crash situation.

Class 2: Road Call. A failure resulting in an en route interruption of revenue service. Service is discontinued until the bus is replaced or repaired at the point of failure.

Code. A legal requirement.

Curb Weight. Weight of vehicle, including maximum fuel, oil and coolant; and all equipment required for operation and required by this Specification, but without passengers or driver.

dBA. Decibels with reference to 0.0002 microbar as measured on the "A" scale.

DC to DC Converter. A module which converts a source of direct current (DC) from one voltage level to another.

Default Configuration Bus. The bus described if no alternatives are selected. Signing, colors, the destination sign reading list and other information must be provided by the Agency.

Destroyed. Physically made permanently unusable.

Discrete Signal. A signal that can take only pre-defined values, usually of a binary 0 or 1 nature where 0 is battery ground potential and 1 is a defined battery positive potential.

Driver's Eye Range. The 95th-percentile ellipse defined in SAE Recommended Practice J941, except that the height of the ellipse shall be determined from the seat at its reference height.

Energy Density. The relationship between the weight of an energy storage device and its power output in units of watt-hours per kilogram (Wh/kg).

Fire Resistant. Materials that have a flame spread index less than 150 as measured in a radiant panel flame test per ASTM-E 162-90.

Fireproof. Materials that will not burn or melt at temperatures less than 2,000°F.

Free Floor Space: Floor area available to standees, excluding the area under seats, area occupied by feet of seated passengers, the vestibule area forward of the standee line, and any floor space indicated by manufacturer as non-standee areas such as, the floor space "swept" by passenger doors during operation. Floor area of 1.5 sq ft shall be allocated for the feet of each seated passenger that protrudes into the standee area.

GAWR (Gross Axle Weight Rated). The maximum total weight as determined by the axle manufacturer, at which the axle can be safely and reliably operated for its intended purpose.

Gross Load. 150 lbs for every designed passenger seating position, for the driver, and for each 1.5 square feet of free floor space.

GVW (Gross Vehicle Weight). Curb weight plus gross load.

GVWR (Gross Vehicle Weight Rated): The maximum total weight as determined by the vehicle manufacturer, at which the vehicle can be safely and reliably operated for its intended purpose.

Heavy Heavy-Duty Diesel Engine (HHDD). Heavy heavy-duty diesel engines have sleeved cylinder liners, are designed for multiple rebuilds, and a rated horsepower that generally exceeds 250.

HIC (Head Injury Criteria). The following equation presents the definition of head injury criteria:

$$\left[\frac{1}{t_2 - t_1}\int_{t_1}^{t_2}(a)\,dt\right]^{2.5}(t_2 - t_1)$$

where:

a = **the resultant acceleration at the center of gravity of the head form expressed as a multiple of g, the acceleration of gravity.**

t1 and t2 = **any two points in time during the impact.**

High Voltage (HV). Greater than 50 volts (AC and DC).

Hose: Flexible line.

Human Dimensions: The human dimensions used in Part III: Technical Specifications are defined in Humanscale 1/2/3, N. Diffrient, A. R. Tilley, J. C. Bardagiy, MIT Press.

Inverter. A module that converts DC to and from AC.

Labeled. Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization, which is acceptable to the authority having jurisdiction and concerned with product evaluation, which maintains periodic inspection of production labeled equipment or materials, and by

whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Line: All tubes, flexible and hard, that carry fluids.

Local Regulations. Regulations below the state level.

Low-Floor Bus. A bus that, between at least the front (entrance) and rear (exit) doors, has a floor sufficiently low and level so as to remove the need for steps in the aisle between the doors and in the vicinity of these doors.

Low Voltage (LV). 50 volts or less (AC and DC).

Maintenance Personnel Skill Levels. Defined below are maintenance personnel skill levels used in Part III: Technical Specifications.

a. 5M: Specialist Mechanic or Class A Mechanic Leader
   (equivalent to DTPW – Bus Technician)
b. 4M: Journeyman or Class A Mechanic
   (equivalent to DTPW – Bus Technician)
c. 3M: Service Mechanic or Class B Servicer
   (equivalent to DTPW – Bus Technician)
d. 2M: Mechanic Helper or Bus Servicer
   (equivalent to DTPW – Bus Hostler)
e. 1M: Cleaner, Fueler, Oiler, Hostler, or Shifter
   (equivalent to DTPW – Bus Hostler)

Note: Whenever a specific time is indicated to access components or complete a task, it is assumed the vehicle is in the location where the work is to be performed. All necessary equipment is in its correct position (tools, jacks, vehicle lifts, lighting, fluid recovery systems, etc.) and ready for use.

Metallic Hose. A hose whose strength depends primarily on the strength of its metallic parts; it can have metallic liners or covers, or both.

Module. Assembly of individual components

Motor (Electric). A device that converts electrical energy into mechanical energy.

Motor (Traction). An electric motor used to power the driving wheels of the bus.

Physical Layer. The first layer of the seven-layer International Standards Organization (ISO) Open Systems Interconnect (OSI) reference model. This provides the mechanical, electrical, functional and procedural characteristics required to gain access to the transmission medium (e.g., cable) and is responsible for transporting binary information between computerized systems.

Pipe: Nonflexible line.

Power. Work or energy divided by time

Power Density. Power divided by mass, volume or area.

Propulsion System. System that provides propulsion for the vehicle proportional to operator commands.

Real-Time Clock (RTC). Computer clock that keeps track of the current time.

Retarder. Device used to augment or replace some of the functions of primary friction based braking systems of the bus.

Seated Load. 150 lbs for every designed passenger seating position and for the driver.

SLW (Seated Load Weight). Curb weight plus seated load.

Serial Data Signals. A current loop based representation of ASCII or alphanumeric data used for transferring information between devices by transmitting a sequence of individual bits in a prearranged order of significance.

> **NOTE:** An example is the communication that takes place between two or more electronic components with the ability to process and store information.

Solid State Alternator. A module that converts high-voltage DC to low-voltage DC (typically 12/24 volt systems).

Special Tools. Tools not normally stocked by the Agency.

Specification. A particular or detailed statement, account, or listing of the various elements, materials, dimensions, etc. involved in the manufacturing and construction of a product.

Standard. A firm guideline from a consensus group.

Standards. Standards referenced are the latest revisions unless otherwise stated.

Standee Line. A line marked across the bus aisle to designate the forward area that passengers may not occupy when the bus is moving.

State of Charge (SOC). Quantity of electric energy remaining in the battery relative to the maximum rated Amp hour (Ah) capacity of the battery expressed in percent. This is a dynamic measurement used for the energy storage system. A full SOC indicates that the energy storage system cannot accept further charging from the engine driven generator or the regenerative braking system.

Stress Loops. The “pig-tails” commonly used to absorb flexing in piping.

Structure. The structure shall be defined as the basic body, including floor deck material and installation, load bearing external panels, structural components, axle mounting provisions and suspension beams and attachment points.

Usable Battery Capacity. Usable Battery capacity is measured in kWhr and would be the energy available for normal operations. Usable Battery Capacity would be the usable energy from the ESD as managed through the BMS, Assumed to be less than the gross capacity. It is calculated based on a useful range of something above 0% SOC and something less than 100% SOC, i.e., as an example, if the range was between 10% and 90% SOC, then the usable battery capacity would be 80% of gross battery capacity

Warrantable End of Life (WEOL). WEOL is measure of battery degradation determined as the point at which the batteries can no longer provide the energy or power required to meet the design operating profile. It is expressed as a percentage of remaining battery capacity as compared to gross capacity at the beginning of useful life. For purposes of this specification, WEOL shall be a measure of the useful and intended life of the energy storage device. This measure shall be a percentage of remaining useful capacity based on degradation from the beginning capacity, i.e. kWhr and is used in the overall calculation of mileage range. WEOL shall be used as a condition for battery replacement and to potentially initiate warranty claims.

Wheelchair. A mobility aid belonging to any class of three- or four-wheeled devices, usable indoors, designed for and used by individuals with mobility impairments, whether operated manually or powered. A "common wheelchair" is such a device that does not exceed 30 in. in width and 48 in. in length measured 2 in. above the ground, and does not weigh more than 600 lbs when occupied.

TS 2.1 Abbreviations

The following is a list of abbreviations used in these Technical Specifications.

ADA	Americans with Disabilities Act
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASTM	American Society for Testing and Materials
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EMI	Electromagnetic Interference
EPA	U.S. Environmental Protection Agency
FMEA	Failure Modes and Effects Analysis
FMCSR	Federal Motor Carrier Safety Regulations
FMVSS	Federal Motor Vehicle Safety Standards
FTA	U.S. Federal Transit Administration
IAS	International Approval Services
I/O	Input/Output
ISO	International Organization for Standardization
JIC	Joint Industrial Council
LED	Light Emitting Diode
LEL	Lower Explosive Limit
MAWP	Maximum Allowable Working Pressure
MPH	Miles Per Hour
NAFTP	The National Alternative Fuel Training Program
NATEF/ASE	The National Automotive Technicians Education Foundation/ Automotive Service Excellence
NFPA	National Fire Protection Association
NHTSA	National Highway Traffic Safety Administration
OEM	Original Equipment Manufacturer

OSHA	Occupational Safety and Health Administration
PRD	Pressure Relief Device
RFI	Radio Frequency Interference
SAE	SAE International
SPI	Society of the Plastics Industry
TRC	Texas Railroad Commission
UL	Underwriters Laboratories
USDOT	United States Department of Transportation

TS 3. Referenced Publications

The documents or portions thereof referenced within this specification shall be considered part of the requirements of the specification. The edition indicated for each referenced document is the current edition, as of the date of the issuance of this specification.

TS 4. Legal Requirements

The Contractor shall comply with all applicable federal, state and local regulations. These shall include but not be limited to Federal ADA, as well as state and local accessibility, safety and security requirements. Local regulations are defined as those below the state level.

Buses shall meet all applicable FMVSS and shall accommodate all applicable FMCSR regulations in effect at location of the Agency and the date of manufacture.

The bus shall comply with the most current revision of Florida Department of Transportation (FDOT) Rule 14-90 and most current revision of DOT Part 38--ADA Accessibility Specifications for Transportation Vehicles [Code of Federal Regulations: Title 49, Volume 1), and Society of Automotive Engineers (S.A.E.) recommended practices.

In the event of any conflict between the requirements of these specifications and any applicable legal requirement, the legal requirement shall prevail. Technical requirements that exceed the legal requirements are not considered to conflict.

Contractor should submit certifications with their bid submittal certifying that they comply with the all the legal requirements listed above in this section.

TS 5. Overall Requirements

The Contractor shall ensure that the application and installation of major bus subcomponents and systems are compliant with all such subcomponent vendors' requirements and recommendations. A detailed description of bus components and systems shall be submitted to DTPW for review and approval prior to production. The application and installation of all major bus sub-components and systems shall be validated by the sub-components and /or system manufacturer prior to the delivery of the first article.

A life cycle cost analysis per bus should be submitted to DTPW for review with the proposal.

Components used in the vehicle shall be of heavy-duty design and proven in transit service.

Whenever a specific trade or product name is used within this specification, the following statement applies "…or approved equal with the same standards of quality, design and performance." All requests for approved equals must be submitted to DTPW for review.

TS 5.1 Weight

It shall be a design goal to construct each bus as light in weight as possible without degradation of safety, appearance, comfort, traction or performance.

Buses at a capacity load shall not exceed the tire factor limits, brake test criteria or structural design criteria.

TS 5.2 Capacity

The vehicle shall be designed to carry the gross vehicle weight, which shall not exceed the bus GVWR.

TS 5.3 Service Life

The minimum useful design life of the bus in transit service shall be at least twelve (12) years or 500,000 miles. It shall be capable of operating at least 40,000 miles per year, including the 12th year.

TS 5.4 Maintenance and Inspection

Scheduled maintenance tasks shall be related and shall be in accordance with the manufacturer's recommended preventative maintenance schedule and must conform to DTPW's standard inspection intervals of 6,000 miles (along with routine daily service performed during the fueling operations).

NOTE**:** Tools such as compartment door keys and other tools that are required for daily maintenance and inspections shall not be included in the special tool list and shall be furnished for each coach.

The contractor should provide a list of the time required for typical repair and servicing of items on the bus.

Test ports shall be provided for commonly checked functions on the bus such as but not limited to hydraulic, pneumatic, HVAC, cooling systems, voltage, current and state of charge (SOC). Fluid sampling ports (KP Series Pushbutton Sampling Valve) for hydraulic systems shall be provided.

The coach manufacturer shall give prime consideration to the routine problems of maintaining the vehicle and charging equipment. All coach and charging station components and systems, both mechanical and electrical, which will require periodic physical work or inspection processes shall be installed so that a minimum of time is consumed in gaining access to the critical repair areas. It shall not be necessary to disassemble portions of the coach structure and/or equipment such as seats and flooring under seats in order to gain access to these areas. Each coach shall be designed to facilitate the disassembly, reassembly, servicing or maintenance, using tools and equipment that are normally available as standard commercial items.

Requirements for the use of unique specialized tools will be minimized. The body and structure of the coach shall be designed for ease of maintenance and repair. Individual panels or other equipment which may be damaged in normal service shall be repairable or replaceable. Ease of repair shall be related to the vulnerability of the item to damage in service.

The proposer should provide a list of all special tools and pricing for maintaining this equipment. Said list should be submitted as a supplement to the Pricing Schedule.

> **NOTE:** Tools such as compartment door keys, bellows gauges and other tools that are required for daily maintenance and inspections shall not be included in the special tool list and shall be furnished for each bus.

All shields and removable plates shall have the bus number permanently marked.

All removable caps shall be tethered including the caps for the diagnostic connector ports in the operator's area and in the engine compartment.

The location for checking and adding fluids, or making adjustments to key components and systems, shall be convenient and easily accessible. Access doors for checking vital fluids on the inside of the bus shall be kept to a minimum.

TS 5.5 Interchangeability

Unless otherwise agreed, all units and components procured under this Contract, whether provided by Suppliers or manufactured by the Contractor, shall be duplicates in design, manufacture and installation to ensure interchangeability among buses in each order group in this procurement. This interchangeability shall extend to the individual components as well as to their locations in the buses. These components shall include, but are not limited to, passenger window hardware, interior trim, lamps, lamp lenses and seat assemblies. Components with non-identical functions shall not be, or appear to be, interchangeable.

Any one component or unit used in the construction of these buses shall be an exact duplicate in design, manufacture and assembly for each bus in each order group in this Contract. Contractor shall identify and secure approval for any changes in components or unit construction provided within a Contract.

In the event that the Contractor is unable to comply with the interchangeability requirement, the Contractor must notify the Agency and obtain the Agency's prior written approval, including any changing in pricing.

Agency shall review proposed product changes on a case-by-case basis and shall have the right to require extended warranties to ensure that product changes perform as least as well as the originally supplied products.

TS 5.6 Training

The Contractor shall have at least one qualified instructor who shall be available at the DTPWs property for 120 calendar days between the hours of 7:00 am and 3:00 pm per month for 1 months prior to, and 3 months after, acceptance of the first bus. Instructor(s) shall conduct schools and advise the personnel of the DTPW on the proper operation and maintenance of the equipment. The Contractor also shall provide visual and other teaching aids (such as manuals, slide presentations and literature) for use by the Agency's own training staff and which become the property of the Agency.

The Contractor shall provide an approved instruction program for designated Transportation and Maintenance personnel in the proper methods of operating, maintaining and servicing buses provided to DTPW by the Contractor. The training program shall be divided into two (2) complete sections, one for Maintenance personnel and the other for Transportation personnel.

Ninety (90) days before the scheduled delivery date of the first bus, schedules and lesson plans shall be provided for DTPW approval for both the Maintenance and Transportation training programs. As part of the lesson plan, the Contractor shall include the name of the instructors. Utilization of vendor presenters is encouraged and supported by DTPW. The Contractor is responsible for scheduling and costs of vendor presenters. As part of the training schedule, Contractor shall inform DTPW of any equipment needed to make the presentation, such as but not limited to audio/visual equipment, blackboards, wipe boards, flip charts, and overhead or slide projectors.

Maintenance Training

The Contractor shall provide a complete training and instruction program for DTPW's designated mechanics, service personnel, and supervisors covering preventative maintenance, troubleshooting, and repair of the buses the Contractor will be providing DTPW. The instruction program shall be in self-contained modules, or subject areas, with each module divided into two (2) phases, a pre-delivery phase and a post-delivery phase. Each module or subject shall be covered at least twice, unless otherwise noted. The pre-delivery training

must be completed by the scheduled delivery of the first bus. It is DTPW's intent that the post-delivery phase of each module be designed as hands on troubleshooting on an actual bus. As an example, DTPW may mandate thirty-two (32) hours of training for a particular module or subject area which may be divided into sixteen (16) hours of pre-delivery training and sixteen (16) hours of post-delivery training.

Many of the classes will be held during DTPW's three (3) shifts of operation. Exact schedules will be negotiated between DTPW's training personnel and the Contractor.

DTPW will limit the number of personnel in each class to twenty (20) or less so that class size will be manageable. Personnel attending each module or class will be designated by DTPW with a list of attending individuals available to Contractor. All attendance records will be kept by DTPW's Training Division.

The Maintenance training and instruction program shall cover (but not be limited to) the following areas:

A.	Orientation	I.	Suspension, Steering, Axles
B.	Electrical	J.	Body
C.	Powertrain	K.	Parts
D.	Charging Station	L.	Service Instruction
E.	Air Conditioning	M.	Ramp Equipment
F.	Doors	N.	Towing
G.	Brakes	O.	Fire Suppression
H.	Air System	P.	Other systems not herein listed but supplied

Contractor shall inform DTPW of any special equipment that requires training before the bus is put into revenue service.

Maintenance Training Program Content

Orientation Module

- Advantages and Strong Points of the Bus.
- Visuals of Production System of the Bus.
- Compartment-by-Compartment Tour of the Bus.
- Special Components or Features of the Bus.

The orientation module will consist only of a pre-delivery session with no post-delivery instruction. DTPW suggests that the orientation module be limited to four (4) hours with one fifteen minute break. The orientation module shall be repeated eight (8) times.

Electrical/Electronics

- Location of all key electrical components found on the bus.
- Explanation of the wiring diagram and wiring codes with copies of wiring diagrams given to each attendee.
- Explanation of the charging system along with basic troubleshooting of the system.
- Explanation of the Exterior and Interior Lighting system along with basic troubleshooting of the system.
- Explanation of the safety shutdown system, including the warning indicators, along with basic troubleshooting of system.

Contractor shall provide a module consisting of a minimum of ten (10) eight-hour days of pre-delivery classroom instruction, followed by a minimum of twelve (12) eight-hour days troubleshooting on a bus.

Powertrain and Accessories

- Explanation of the powertrain and the location of key components.
- Explanation of the powertrain driven accessories.
- Explanation of the lubrication, and cooling systems.
- Basic troubleshooting procedures for the powertrain
- Explanation of the electronic control system.

The emphasis of any powertrain module should be basic troubleshooting and preventative maintenance procedures. The basic powertrain course shall consist of ten (10) eight-hour days of pre-delivery classroom instruction and twelve (12) eight-hour days of post-delivery classroom instruction on a bus.

Charging Station

- Explanation of the Charging Station
- Basic troubleshooting of the Charging Station

The Charging Station training course shall consist of basic troubleshooting and preventative maintenance. The course shall consist of a minimum of four (4) eight-hour days of pre-delivery classroom instruction and five (5) eight-hour days of trouble shooting on the bus.

Air Conditioning

- Explanation of the Air Conditioning system and the location of all key air conditioning components (handouts required).
- Explanation of the Air Conditioning Electrical System.
- Explanation of the Air Conditioning Compressor, along with basic troubleshooting and preventative maintenance of the air conditioning compressor.
- Basic troubleshooting of the air conditioning system.
- Preventative maintenance of the air conditioning system.

DTPW will require a minimum of four (4) eight-hour days of pre-delivery classroom instruction and six (6) eight-hour days of post-delivery instruction on the troubleshooting.

Doors

- Explanation of the door system and the location of all door components.
- Explanation of the door electrical system.
- Proper door adjusting procedures.
- Basic troubleshooting of the door system.
- Rebuilding of the door motors (may be taught as a separate course).

The door module shall consist of four (4) four-hour sessions of pre-delivery classroom instruction and four (4) four-hour sessions of hands-on post-delivery troubleshooting.

Brakes

- Explanation of the Brake System.
- Basic brake system repair, including adjustments to brakes.

The brake module shall consist of four (4) four-hour sessions of pre-delivery classroom instruction and six (6) four-hour sessions of post-delivery instruction on the brake system on the bus.

Air System

- Explanation of the air system with the location of all air system components.
- Basic troubleshooting of the air system.
- Preventative Maintenance of the air system.

The Contractor shall provide an air system module consisting of four (4) four-hour sessions of pre-delivery classroom instruction and six (6) four-hour sessions of post-delivery troubleshooting instruction on a bus.

Suspension, Steering, Axles

- Explanation of the suspension system.
- Basic repair to the suspension system.
- Basic troubleshooting of the suspension system.
- Explanation of the steering system.
- Basic troubleshooting of the steering system.
- Explanation of the axles.
- Explanation of the articulation system.
- Basic troubleshooting of the articulation system.

DTPW requires a minimum of four (4) four-hour sessions of pre-delivery classroom instruction and four (4) four-hour sessions of post-delivery troubleshooting instruction on a bus.

Body

- Explanation of the body and the attachment method of exterior panels.
- Basic repair of the exterior panels.
- Demonstration of windshield and passenger window replacement.

DTPW requires that the body module be a minimum of four (4) four-hour sessions of pre-delivery training and four (4) four-hour sessions of post-delivery instruction on a bus.

Parts

- Explanation of the Parts Manual and how it is divided.
- Explanation of the parts numbering system.
- Orientation to the bus and components on the bus.
- Practice in finding parts in the Parts Manual.

DTPW requires the Parts module to be a minimum of two (2) four-hour sessions of pre-delivery instruction. No post-delivery instruction will be required.

Service Instruction (For Service, and Cleaning Personnel)

- Operator Compartment
  - Controls and Switches
  - Warning Indicators and gauges
  - Seat Adjustment
  - Door Control
  - Wheelchair Ramp Operation

- Walk Around Inspection
  - Compartment by Compartment Explanation of Service Points
  - Battery Charging
  - Mirror Adjustments
  - Climate Control System

DTPW requires that the Service Instruction module be presented at each garage where buses will be assigned. This module shall consist of ten (10) four-hour sessions.

Wheelchair Ramp

- Explanation of the Ramp System, mechanisms and controls.
- Inspection and Periodic Maintenance of the Wheelchair Ramp mechanism.
- Trouble shooting of hydraulic and electrical components.

The Contractor shall provide comprehensive training on this critical system. The training program shall consist of four (4) four-hour sessions of pre-delivery instruction and four (4) eight-hour sessions of post-delivery instruction.

Towing

The Contractor shall provide lifting and towing instruction and demonstration for DTPW's maintenance personnel consisting of four (4) four-hour sessions utilizing DTPW's lifting equipment and an actual bus. The towing equipment shall be provide by the Contractor at its own expense.

Automatic Fire Suppression

- Location of key components on the bus
- Theory of operation
- Explanation of Electrical Wiring
- Basic Troubleshooting
- Preventative Maintenance

The Fire Suppression System training shall consist of four (4) four-hour sessions of post-delivery instruction.

Transportation Training

Training Program

The Contractor shall provide complete training and instruction for DTPW designated Bus Operator Instructors, Street Supervisors and Dispatchers. The program shall include, but not be limited to the following:

Operator Compartment

- Controls and Switches.
- Warning Indicators and Gauges.
- Seats Adjustment.
- Door Control.

Walk Around Inspection

- Compartment-by-Compartment Explanation
- Mirror Adjustments

- Climate Control system
- Battery Safety

Driving Instruction

- Turns
- Braking
- Backing.

Wheelchair Ramp Equipment

- Controls
- Safety
- Emergency Procedures
- Securing Wheelchairs and Riders
- Loading and Unloading

The Transportation Training Program shall consist of a four (4) hour module on the bus ten (10) times. Each trainee will be given an opportunity to operate the bus with the Contractor's instructor on board. The Contractor shall provide the Transportation Training Program ten times.

The Contractor shall provide a training video for DTPW instructors to use for training bus operators on the operation of the bus no later than 30 days after delivery of the first bus of the first lot. The video shall include but not be limited to bus startup and shutdown, rear start, battery disconnect, operational characteristics, instruments and controls, dashboard indicators, wheelchair ramp operation and emergency manual operation, loading and unloading wheelchair passengers, wheelchair passenger securement, pre-trip inspection, safety and emergency procedures. The video content must be approved by DTPW. The Contractor shall give DTPW permission to duplicate the video for DTPW use.

Training Program Aids

The Contractor shall provide fifty (50) sets of instructional material hand-outs for each pre-delivery and post-delivery training module as listed in paragraph 8.1 items B through P. The Orientation program shall be supplied with 100 hand-outs. This instructional material will be kept by the individuals to allow them to retain and remember salient areas of training and instruction modules. DTPW will work with the Contractor to help develop this instruction. The Contractor shall write all instructional material in clear, simple English, keeping in mind that many individuals in the training course have minimum literacy skills (6th grade reading level).

The use of slides, view graphs and other visuals is required in the pre-delivery training classes to allow the trainees the opportunity to see the actual location of the components, the size of the components and the physical appearance of the subject.

DTPW reserves the right to duplicate, at its expense, all films, slides, view graphs, tapes and handouts for its sole use in follow-up reinforcement training at the option of DTPW's Training Division. Unless an Instructor objects in writing, DTPW reserves the right to video tape/or audio tape all Contractor and vendor presentations for its sole use without further costs, obligation or liability to DTPW.

Training Facilities

All training will be conducted at DTPW facilities or facilities secured by DTPW. The Contractor shall inform DTPW in the lesson plans of any special facilities needed. DTPW will assist the Contractor in the set up and tear down of training aids and models used in the presentations.

Training Instructors

All training instructors shall be competent to teach the course area they are instructing. Further, all instructors shall speak English and have a complete understanding of the English language. If the instructor or vendor presenter lacks the skill or knowledge to provide instruction, or cannot communicate with the students, DTPW reserves the right to request that the instructor be replaced and the area of training be repeated.

Supervisor Training

In addition to the in-depth training described above, the Contractor shall provide a series of five (5) short courses of four (4) hours each for Maintenance Supervisors. These courses shall be designed to give the Maintenance Supervisors an overview of each system listed in the Maintenance Training Program Content. The class size will be kept to a manageable number. The courses are intended to allow the supervisors to better understand the bus and how to troubleshoot some of the common problems. DTPW will work with the Contractor to develop these supervisory training courses.

Data Communications Systems Training

Separate from the Maintenance and Transportation training described above, the Contractor shall provide and arrange for one-hundred (100) hours of training for Systems Maintenance Technicians, to be given by the suppliers of the various Data Communications Equipment provided with the buses. This training shall include in-depth component level repair and programming. Classes and times will be determined by the Chief, Field Engineering and Systems Maintenance.

Training Hours Summary

Maintenance Summary	Pre-Delivery	Post-Delivery
Orientation	8 X 4 = 32	---
Electrical	10 X 8 = 80	12 X 8 = 96
Powertrain	10 X 8 = 80	12 X 8 = 96
Charging Station	4 X 8 = 32	5 X 8 = 40
Air Conditioning	4 X 8 = 32	6 X 8 = 48
Doors	4 X 4 = 16	4 X 4 = 16
Brakes	4 X 4 = 16	6 X 4 = 24
Air System	4 X 4 = 16	6 X 4 = 24
Steering, Suspension, Axles	4 X 4 = 16	4 X 4 = 16
Body	4 X 4 = 16	4 X 4 = 16
Parts	2 X 4 = 8	---
Maintenance Service Instruction		10 X 4 = 40
Wheelchair Equipment	4 X 4 = 16	4 X 8 = 32
Towing	---	4 X 4 = 16

Fire Suppression	---	4 X 4 = 16
	---	---
Total Maintenance	360 Hours	480 Hours
Transportation		10 X 4 = 40
Supervisory Orientation		5 X 4 = 20
Data Communications Systems Training		100 Hours
GRAND TOTAL	360 Hours	640 Hours
COMBINED TOTALS	1000 Hours	

Pricing

The training program provided by the Contractor shall be included in the bus price.

A complete 1000 hours training program shall be provided. DTPW may adjust (increase or reduce) the hours specified for each topic where its works force already possesses adequate knowledge of a particular system or specific equipment.

TS 5.7 Technical/Service Representatives

The Contractor shall be responsible to have a knowledgeable individual, conversant with its bus and componentry, meet no less than once each month at the DTPW offices in Miami, Florida to deal with day-to-day problems which may occur during the "Basic Bus Warranty" period. During the period of "Bus Delivery" this requirement shall be "full time". The Contractor's Representative shall have authority to settle disputes, agree on corrective measures and shall be empowered to bind the Contractor to any and all agreements he makes. This provision shall continue in force until relinquished or amended in writing by DTPW.

In addition, the Contractor shall provide at its own expense, one or more “full-time” competent technical service representatives on site at DTPW facilities, to perform warranty repairs and supply technical support for a period of one year minimum, beginning from the date of acceptance of the last bus delivered.

TS 5.8 Operating Environment

The Bus shall operate normally under all environmental conditions usually occurring in the DTPW’s service area. Specific conditions include ambient temperatures which range from 20 degrees F. to 120 degrees F. at relative humidity between five (5) and one hundred (100) percent.

Speed, gradability, and acceleration performance requirements shall be met at, or corrected to 85 degrees F., 29.00 inches Hg, and relative humidity of 65 percent.

Miami-Dade County experiences severe rain conditions and as such, special attention must be given to ensure that no water leaks occur in the bus.

TS 5.9 Noise

Interior Noise

The combination of inner and outer panels and any material used between them shall provide sufficient sound insulation so that a sound source with a level of 80 dBA measured at the outside skin of the bus shall have a sound level of 65 dBA or less at any point inside the bus. These conditions shall prevail with all openings, including doors and windows, closed and with the engine and accessories switched off.

The bus-generated noise level experienced by a passenger at any seat location in the bus shall not exceed 80 dBA. The driver area shall not experience a noise level of more than 75 dBA.

An exception shall be made for the turntable area (where applicable), which shall be considered a separate environment.

It is DTPW's intent to minimize the noise experienced by passengers, and as such, the Contractor shall offer any optional or additional noise deadening insulation or noise reduction technologies available, as standard on the bus. DTPW will consider any reduction of bus generated interior noise below the maximum specified.

Proposers should submit test information to DTPW with request for approved equals.

Exterior Noise

Airborne noise generated by the bus and measured from either side shall not exceed 80 dBA under full power acceleration when operated 0 to 35 mph at curb weight. The maximum noise level generated by the bus pulling away from a stop at full power shall not exceed 83 dBA. The bus-generated noise at curb idle shall not exceed 65 dBA. If the noise contains an audible discrete frequency, a penalty of 5 dBA shall be added to the sound level measured. The Contractor shall comply with the exterior noise requirements defined in local laws and ordinances identified by the Agency and SAE J366.

Proposers should submit test information to DTPW with request for approved equals.

TS 5.10 Fire Safety

The bus shall be designed and manufactured in accordance with all applicable fire safety and smoke emission regulations including but not limited to FMVSS 302. These provisions shall include the use of fire-retardant/low-smoke materials, fire detection systems, bulkheads and facilitation of passenger evacuation.

The buses shall be equipped with a suitable means of automatically detecting and extinguishing fires. This system shall include a UPS (Uninterruptable Power Supply) capable of sustaining operation for a period of at least 72 hours regardless of the primary energy source SOC and remain uninterrupted regardless of "run" / "ign" position. The system controller shall include a means of data logging and storage such that incident data is recoverable and periodic system health checks. The quantity, location and technology for sensors, suppression, agents, etc. shall be best practice for the intended application and environment. Fire suppression piping located in the immediate area (s) being protected shall be fireproof and capable of surviving gross thermal events, the subject piping shall include the flow path between the fire suppression bottle and nozzles, metalized rigid / flexible, stainless steel preferred. The preferred supplier for the system shall be Amerex.

The system design, hardware location and access shall be such that those items required for periodic inspection are readily available for ease of access and viewing. An inspection door shall be provided by the Contractor on the bus body allowing for visual site inspection of the agent cylinder gauge.

Materials used in the construction of the Passenger Compartment of the bus shall be in accordance with the Recommended Fire Safety Practices defined in FTA Docket 90A, dated October 20, 1993. Materials entirely enclosed from the passenger compartment, such as insulation within the sidewalls, need not comply. In

addition, smaller components and items, such as seat grab rails, switch knobs and small light lenses, shall be exempt from this requirement.

Automatic Fire Suppression

The vehicle shall be equipped with an Amerex ABC dry chemical fire suppression system model V25 or approved equal. The system shall be approved and listed for use at –65 degrees F to 150 degrees F by Factory Mutual Research Corporation. The automatic actuation system shall provide 24 hour fire detection of the engine compartment. The system shall include the following features:

- A minimum 25 pound capacity agent cylinder of the stored pressure type shall be furnished and be constructed of welded steel and must conform to DOT specification 4BW, and be rated for 12 year minimum hydrostatic retest. The cylinder shall be outfitted with a gauge and a forged brass valve assembly.

- A minimum of four (4) optical flame sensors shall be located in the engine compartment. The electric control head shall also be activated manually by depressing an electric switch (button w/ pull pin, labeled 'fire') mounted in the driver's dash area.

- A Control Panel shall be provided to electrically supervise the automatic fire suppression system wiring circuits for POWER, HEAT DETECTION, and SYSTEM ACTUATION. The monitor shall provide a display indicating NORMAL, FIRE or FAULT conditions, and the panel will shut the bus down within 15 seconds or less of detecting a fire. A shut down rest button on the panel will be included.

- A minimum of four (4) brass nozzles shall be located in the engine compartment (and/or other locations as recommended), fitted with dust caps that, upon actuation, are displaced to allow full ABC chemical flow.

- Protective sleeves (high temperature resistant material) shall be provided to all the fire suppression system hoses enclosed in the engine compartment area.

- The bus Contractor shall provide a written sign off from the fire suppression manufacturer that all installation requirements have been met on the pilot bus system.

- An inspection door will be provided by the Contractor on the bus body allowing for visual site inspection of the agent cylinder gauge.

If a rear mounted air-conditioning system is provided, one detector and nozzle shall be located in the upper a/c compartment. DTPW is to approve location of nozzles, detectors, and canister prior to production.

A documentation proving that the pilot bus or first production bus (if no pilot bus available) meets or exceed vehicle fire suppression system requirements shall be provided by the bus manufacturer with a written sign off from the fire suppression manufacturer.

TS 5.11 Respect for the Environment

In the design and manufacture of the bus, the Contractor shall make every effort to reduce the amount of potentially hazardous waste. In accordance with Section 6002 of the Resource Conservation and Recovery Act, the Contractor shall use, whenever possible and allowed by the specifications, recycled materials in the manufacture of the bus.

The Contractor should provide a plan for reuse or recycling of replaced battery cells and/or battery packs both during and after the warranty period.

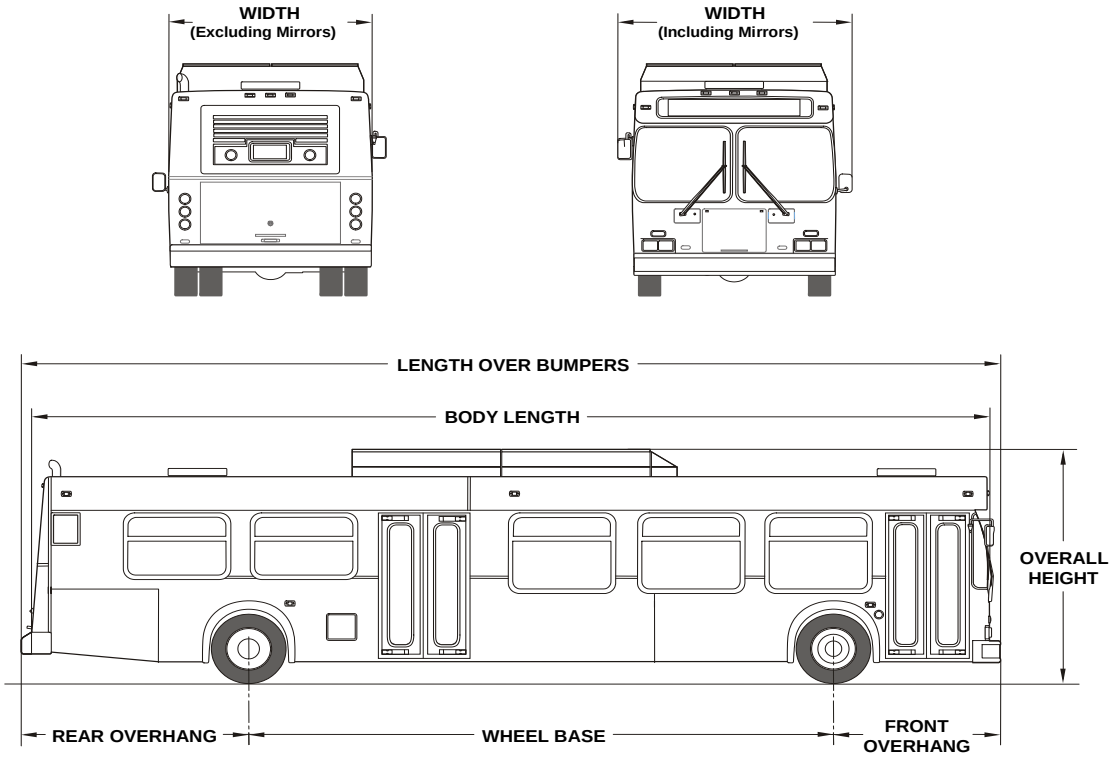
DIMENSIONS

TS 6. Physical Size

With exceptions such as exterior mirrors, marker and signal lights, bumpers, fender skirts, washers, wipers, ad frames, cameras, object detection systems, bicycle racks, feelers and rub rails, the bus shall have the following overall dimensions as shown in Figure 1 at static conditions and design height.

FIGURE 1

FORTY –FOOT AND SIXTY-FOOT BUS DIMENSIONS



TS 6.1 Bus Length

The following tolerances will be allowable for each given bus length. Bus length is determined as the measurement from bumper to bumper.

- **40-ft bus:** 40 ft to 44 ft, 11 in.

TS 6.2 Bus Width

Overall width of buses, excluding mirrors, shall be one-hundred two (102) inches (+0, -1 in.).

TS 6.3 Bus Height

Maximum overall height of buses, including all rigid roof mounted items such as but not limited to A/C, exhaust, fuel system and cover, etc., shall not exceed one-hundred-thirty-seven (137) inches. Height measurements, including the heights specified below, are on a level surface with air suspension system operating at the design running height, with the bus on the manufacturer's recommended tires correctly inflated.

TS 6.4 Step Height

The maximum acceptable entry step height shall be 15.5 inches at the entry door and 15.5 inches at the exit door. The maximum acceptable entry step height kneeled shall be 13 inches.

TS 6.5 Underbody Clearance

The bus shall maintain the minimum clearance dimensions as shown in Figure 2 and defined in SAE Standard J689, regardless of load up to the gross vehicle weight rating.

No part of the bus, other than the wheels, tires or mud flaps, shall touch a flat road surface in a stopped condition with a single tire or a dual set fully deflated.

TS 6.6 Ramp Clearances

The approach angle is the angle measured between a line tangent to the front tire static loaded radius arc and the initial point of structural interference forward of the front tire to the ground.

The departure angle is the angle measured between a line tangent to the rear tire static loaded radius arc and the initial point of structural interference rearward of the rear tire to the ground.

The breakover angle is the angle measured between two lines tangent to the front and rear tire static loaded radius and intersecting at a point on the underside of the vehicle that defines the largest ramp over which the vehicle can roll.

TABLE 2

Angle	40-ft Bus
Approach	8.6 degrees (min.)
Breakover	8 degrees (min.)
Departure	8.7 degrees (min.)

TS 6.7 Ground Clearance

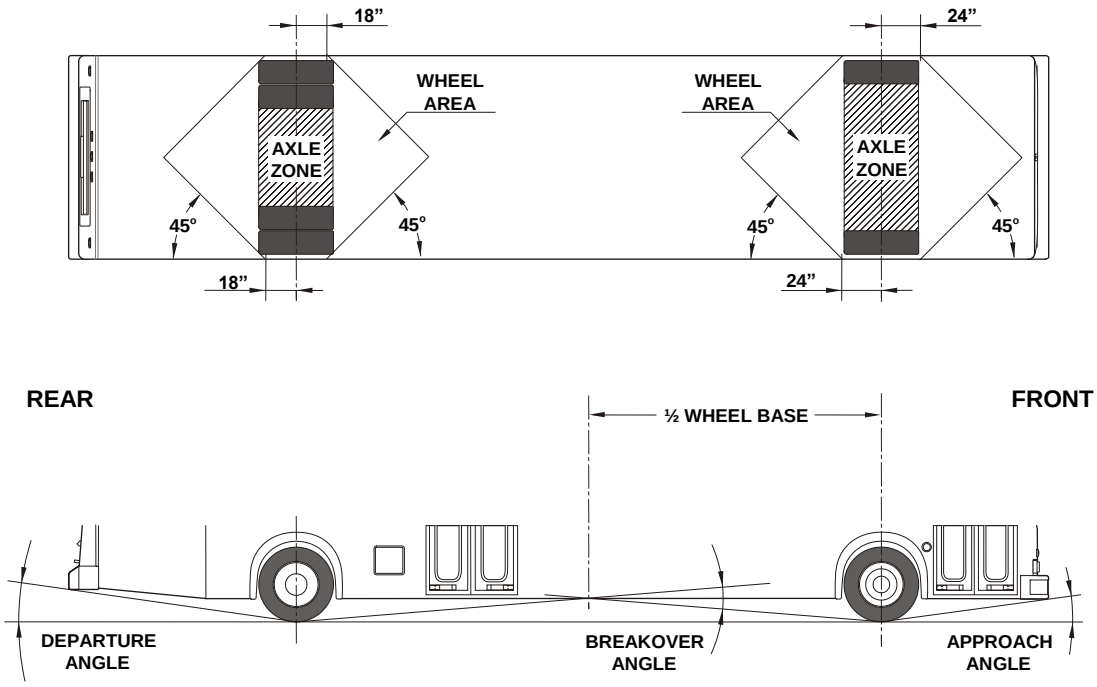
Ground clearance shall be no less than 9 in., (8 in. at jacking pad) except within the axle zone and wheel area.

Axle zone clearance, which is the projected area between tires and wheels on the same axial centerline, shall be no less than five-and-one-half (51/2) inches.

Wheel area clearance shall be no less than 8 in. for parts fixed to the bus body and 6 in. for parts that move vertically with the axles.

FIGURE 2

TRANSIT BUS MINIMUM ROAD CLEARANCE



Forty-Foot Bus

TS 6.8 Floor Height

Height of the floor above the street shall be no more than 15½ inches measured at the centerline of the front doorway. The floor may be inclined along the longitudinal axis of the bus, and the incline shall be less than 3½ degrees off the horizontal except locally at the door where a maximum 5 degrees slope toward the door is allowed.

It shall be a design goal to reduce the floor height as low as possible to the street level to aid in the boarding and departure of passengers.

TS 6.9 Interior Headroom

Headroom above the aisle and at the centerline of the aisle seats shall be no less than 78 in. in the forward half of the bus tapering to no less than 74 in. forward of the rear settee. At the centerline of the window seats, headroom shall be no lower than 65 in., except for parcel racks and reading lights, if specified. Headroom at the back of the rear bench seat may be reduced to a minimum of 56 in., but it shall increase to the ceiling height at the front of the seat cushion. In any area of the bus directly over the head of a seated passenger and positioned where a passenger entering or leaving the seat is prone to strike his or her head, padding shall be provided on the overhead paneling.

TS 6.10 Aisle Width

The minimum clear aisle width between pairs of transverse seats with all attached hardware shall be at least 22 in.

The aisle width between the front wheelhouses shall be at least 35.5 in., and the entire area between the front wheelhouses shall be available for passengers and mobility aid devices.

VEHICLE PERFORMANCE

TS 7. Power Requirements

The propulsion system shall be sized to provide sufficient power to enable the bus to meet the defined acceleration, top speed, and gradability requirements, and operate all propulsion-driven accessories using actual road test results and computerized vehicle performance data.

The loss of power to the bus shall not cause the driver to lose control of the bus or to lose steering or braking. The bus shall be able to be safely brought to a controlled stop.

TS 7.1 Top Speed

The bus shall be capable of achieving a top speed of 65 mph on a straight, level road at GVWR with all accessories operating but shall be governed at a top speed of 60 m.p.h. The bus shall be capable of safely maintaining the vehicle speed according to the recommendations by the tire manufacturer.

TS 7.2 Gradability

Gradability requirements shall be met on grades with a dry commercial asphalt or concrete pavement at GVWR with all accessories operating. The propulsion system and drive train shall enable the bus to achieve and maintain a speed of 40 mph on a 2½ percent ascending grade and 7 mph on a 16 percent ascending grade.

> **NOTE:** Values are assumed to be sustained. Manufacturer shall supply Agency with data if there is a variance between peak performance and sustained vehicle performance.

TS 7.3 Acceleration

The acceleration shall meet the requirements below starting from a stationary condition, on a level grade, all accessories operating, with a seated load weight (SLW) at 150 pound per passenger. Acceleration measurement shall commence when the accelerator is depressed (idle start). The acceleration shall be sufficiently gradual and smooth to prevent throwing standing passengers off-balance.

Braking application and performance shall remain consistent regardless of system State of Charge (SOC) or other variances related to regenerative braking.

The system shall be programmable to allow optimization of acceleration and deceleration rate. The Contractor shall supply the updated performance data for program revisions.

Maximum Start Acceleration Times on a Level Surface

Speed (mph)	Maximum time (seconds)
10	5
20	10
30	18
40	30
50	60
Top speed	

TS 7.4 Operating Range

The operating range of the coach shall be designed to meet the operating profile as stated in the "Design Operating Profile" section.

TS 7.4.1 Electric

The operating range of the coach with full state of charge and under full GVWR and auxiliary loads shall be at least 175 miles.

TS 8. Fuel Economy (Design Operating Profile)

Test results from the Altoona fuel economy tests or other applicable test procedures shall be provided to DTPW. Results shall include vehicle configuration and test environment information. Diesel equivalent fuel economy data shall be provided for the design operating profile. The design operating profile is assumed to be defined by the Altoona fuel duty cycle.

POWERPLANT

TS 9. Propulsion System (Electric)

Propulsion System Description

The bus shall be powered by a battery electric propulsion system. Function and operation of the bus shall be transparent to the bus operator and passengers. The Contractor shall assure that the bus structure can successfully accept the installation of the propulsion system and be operated on the stated duty-cycle for a period of 12 years without a structural failure. At a minimum, the propulsion system shall comply with applicable local, state, and/or federal emissions and useful life requirements, as a zero emission bus. The propulsion system shall comply with local, state, and federal (maintenance) and other applicable sections.

The Electric Drive System shall be rated for the GVWR or greater of the bus.

Propulsion System Service

The propulsion system shall be arranged so that accessibility for all routine maintenance is assured. No special tools, other than dollies and hoists, shall be required to remove the propulsion system or any subsystems. However, the Agency shall recognize that properly rated test equipment and safe electrical work practices are essential when servicing high voltage components. Contractor shall provide all specialty tools and diagnostic equipment required for maintaining the Propulsion System in accordance with Special Tools List.

Primary Propulsion Unit and Traction Motor

The PPU and traction motor(s) may be configured in a variety of methods dependent upon type of drive, i.e. conventional drive rear axle, wheel motors, etc. The definition of motor in the context of this specification assumes the device can provide or consume electrical energy as well as provide or retard mechanical motion.

Propulsion System Controller (PSC)

The PSC regulates energy flow throughout system components in order to provide motive performance and accessory loads, as applicable, while maintaining critical system parameters (e.g., voltages, currents, temperatures, etc.) within specified operating ranges.

The controller shall monitor and process inputs and execute outputs as appropriate to control the operation of all propulsion system components.

The overall propulsion system and PSC shall include and manage support systems such as, steering, air, HVAC, defroster, etc.

The propulsion system shall be managed via a PSC. This PSC is assumed to be the hub for all propulsion system device to device communication, to include traction motors, energy storage, charging equipment and power switching electronics, and interface to other vehicle systems via J1708, J1939, etc. The PSC shall provide the following functionality:

- Storage of the application file necessary to execute propulsion system commands
- Storage of the buses data file generated on a day to day basis, to include:
  - At a minimum, duty cycle information (time stamp, vehicle speed, elevation, location, ambient temperature, etc.), and energy profile information (i.e., voltage and current from the traction motor, auxiliary systems, ESS, power electronics, onboard charging system, etc.) at 1 sec intervals
  - History of charging sessions, energy in, time stamp, SOC, etc.
  - Incidents and alarms
  - Health monitoring and diagnostics information
- Expert level software such that the bus is optimized per duty cycle on the fly, i.e. “adaptive learning” to consider, route, time of day, etc. The objective is to maintain the buses level of expected performance, meanwhile minimize the cost of the electric utility used for charging. If the proposed PSC controller does not have the capability to perform “adaptive learning”, the Con- tractor must perform parameter tuning to help optimize the efficiency of the vehicle to the given route.
- A means of executing “limp home” instruction such that the bus is able to return to the depot from the furthest point on the route without charge assistance.
- A wireless means of communication to the on route and depot charging stations, and/or if probed via a WLAN in close proximity
- The system is assumed to include current / power sensors at strategic locations throughout the propulsion system components such that real time comparisons can be made between anticipated power flow and actual power. This feature shall facilitate health checking of components to indicate, “open”, “shorted” and/or components that have considerable variance.
- The system is assumed to include the necessary sensor inputs at strategic locations, such as, temperature, voltage, pressure, etc. such that the entire array of devices are monitored in real time. This feature shall be able to execute commands for the self-preservation of component life, health, reliability and safety. The on-board diagnostic system shall trigger a visual and audible alarm to the operator when the motor controller detects a malfunction and the protection systems are activated.
- The system shall protect the traction motor(s) against progressive damage. The system shall monitor conditions critical for safe operation and automatically derate power and/or speed.
- The system shall include a sub-system capable of monitoring the level of connectivity between all propulsion components and associated cabling / connectors to the buses chassis and low (12/24 vdc)

systems to insure isolation. The energy storage module shall have at least two automatic means / devices of disconnect and one manual capable of interrupting the positive and negative connections within the module enclosure, and rated for disconnect at maximum current.

- The system shall have an interlock that prevents engagement when the charger is connected to the traction battery.

The PSC shall be equipped with an electronically controlled management system, compatible with multiplex wiring systems and either 12- or 24-volt electrical systems.

Power Electronics / Inverter

The previously mentioned PSC shall execute instructions and system commands to the propulsion system components via a power electronics switching module, assumed to be an "inverter". This power module shall be the hub for the traction motor, energy storage, charger and all motors / devices necessary for periphery support systems, such as, HVAC, power steering, air system, bus low voltage battery charging, etc. Circuitry for this device (s) shall include all necessary fuses / breakers such that the conductors, components and bus are adequately protected and safe. Connection points shall be keyed / identified such that mismatch is not physically possible. In addition these connection points shall be interlocked, such that a disconnect is automatically accompanied by an interruption at the energy storage module, both + and -. Reconnecting the subject connector (s) will not automatically restore the connection to the energy storage module; a system reset will be required.

Traction System

The traction system shall include the necessary motors, gearing and connection to the drive axle and /or wheel motor driven.

Energy Storage System

Design and performance shall be provided to the Agency. The Energy Storage System (ESS) shall be of a commercial design capable of operating in the Agency transit environment. The ESS shall be designed, sized, and selected to ensure that the vehicle performance specifications, compatibility with charging, and other related requirements are met or exceeded, bearing in mind cost benefit and reliability variables as they relate to the characteristics of the different battery types. The power source for the vehicle shall be derived from established battery technology that has a field-proven track record of safe, reliable, and durable operation in similar traction applications.

The primary charging of the energy storage system shall be accomplished by conductive or inductive charging as needed to meet the required duty cycle. If the primary charging system uses any type of automated service to initiate charging, secondary charging shall be provided from a stationary charging station via a mechanical or manual conductive interface, i.e., plug. The energy storage system shall also make use of regenerative braking. The Energy Storage System shall comply with UN/DOT 38.3 requirements for lithium batteries or similar standards for non-lithium batteries.

The Contractor shall deliver the buses with an installed, fully-charged, functioning ESS. The ESS shall be fully formed, installed and tested in accordance with the battery manufacturer's recommended practices. The ESS design, including containers, module bracing systems, thermal-management systems, battery management systems, watering/venting systems, interconnections, fusing, and traction-controller and charger interfaces should be completely described in the proposal. The batteries shall be warranted for twelve (12) years unlimited mileage. The proposal shall include a detailed analysis of expected battery performance in the Design Operating Profile. The proposal should also include a comprehensive statement of the warranty terms relating to the battery, including explanation of all disclaimers within the warranty. The charge cycle and cycle life should be stated in the proposal and a life cycle cost analysis of the proposed battery system in the specified application should be provided.

The battery system shall be capable of withstanding the high current and voltage profiles necessary to accomplish daily recharge events without reducing the life of the battery. Thermal management will be provided to ensure optimal life and performance of the ESS over the environmental operating range. Battery thermal management system shall be adequate to maintain the battery within the battery manufacturer's recommended temperature range during operation in the specified duty cycle and climatic conditions.

Proposals should include complete descriptions of all life-cycle testing procedures used to validate the life of batteries used this application at the proposed charging rates, charge durations, and expected ambient temperatures and operating profiles. Proposers shall include documented results of life cycle testing.

Proposers should provide documentation and demonstrate the usable battery capacity at 80 percent of gross battery capacity.

Proposers should include certification of battery life cycle testing by independent testing agency.

Energy Storage System Safety

The Energy Storage System shall be placed on the bus to optimize both interior space and vehicle weight distribution. The batteries shall be load distributed within the bus to equalize weight between the wheels on the same axles and to achieve appropriate weight distribution between axles so as not to adversely affect handling of the bus.

The bus body shall be designed and constructed to ensure passengers and the operator will not be exposed to electrical current either in normal operation or in the event of a vehicle accident. Analysis and test data shall be provided to the Agency. The energy storage system shall be designed and constructed to prevent gassing or fumes from the energy storage system from entering the interior of the bus, i.e., a vent path to the exterior, preferably at or above the roof, rearward.

Written confirmation from the battery manufacturer attesting to the safety of the proposed battery system in the specified application and charging profile should be submitted as part of the proposal, and should include full disclosure and discussion of any and all issues or prior incidents relating to safety.

Proposals shall include complete descriptions of all safety standards followed in the design and manufacture of the battery system, safety testing procedures used to validate the safety of battery operation in this application, and documented results of safety testing to confirm that standards have been met. Proposers should include certification of battery safety testing by independent testing agency.

Battery Containers

Battery containers shall be constructed to withstand the rigors of transit service for the design life of the buses. Construction shall be of materials compatible with the battery electrolyte. All electrical connections shall be fully shielded and hand operable. Connector and cabling design shall be such that inappropriate or unsafe connections are not possible. The system shall be designed to allow a single mechanic using a 2-ton capacity forklift to remove and replace the battery within 15 minutes. Vent-and-fill system components for individual packs or containers shall not require any disassembly on removal or installation of the battery packs or containers. Pack design must ensure the protection of battery cabling and vent/watering system components during pack removal and installation. The batteries, when installed, shall be secured to prevent any movement while the vehicle is in operation.

Battery containers shall be supplied by the battery manufacturer. Battery containers supplied by the Contractor are also acceptable provided that such containers are certified by battery manufacturer; such certification shall be submitted to procuring agency concurrent with or prior to delivery of the first bus.

Battery Management System

As a minimum, the battery management system (BMS) must perform the following functions:

A. The BMS system must be capable of monitoring the voltage level of cells within each battery pack. The BMS must be able to read and store individual battery or block voltages at a frequency of 1 data point per block every 15 seconds. The system must also monitor battery pack temperatures using no fewer than 2 thermocouples placed in and around each battery pack sampled at the same 4 samples per minute frequency.

B. The BMS system must be capable of communicating when a battery fault (as defined by the battery manufacturer) has occurred and must be able to identify and communicate the faulty battery in order to perform maintenance.

C. The BMS system must be capable of engaging prudent safety interlocks when an unsafe battery condition has been detected.

D. The BMS system must be able to monitor the battery state-of charge and update a gauge viewed by the operator at least once every 15 seconds.

E. The BMS system must be able to communicate all data to the bus level information system for storage and communication.

Battery Thermal Management

Battery thermal management must be powered from an onboard source at all times. Thermal management must be continuously monitored at all times with appropriate safety interlocks installed to react to adverse conditions as stated in SAE J1772.

Battery temperatures must never exceed the manufacturer's recommended range during operation in the design operating profile and specified ambient conditions. Battery cooling must be sufficient to prevent the temperature from exceeding the battery manufacturer's recommended maximum temperature when the ambient temperature is above 105 degrees F for a period of 16 hours.

Automatic System Protection/Shutdown Override Feature

The system shall monitor conditions critical for safe operation and automatically de-rate power and/or speed and initiate system shutdown as needed. The onboard diagnostic system shall trigger an audible alarm and warning light to signal the operator when a malfunction is detected and the automatic protection system is activated. The system shall protect the traction motor(s) against progressive damage.

Throttle Control

Throttle operation shall be inhibited, through interlocks, whenever:
1. Front or rear door open
2. The vehicle is kneeled
3. Wheelchair ramp is in operation
4. Rear door emergency release

Failure of the throttle control shall not result in an unsafe condition. Loss of air or electrical throttle control shall inhibit throttle.

Engine compartment

Engine compartment lighting shall be provided to adequately illuminate the area for night time service, emergency repairs, or adjustments. Sealed lamp assemblies shall be provided and shall be controlled by a

switch located near the rear start controls in the engine compartment. When the rear engine compartment door is closed the compartment lights shall extinguish automatically.

All removable caps shall be tethered including the caps for the diagnostic connector ports in the operator's area and in the engine compartment.

The Contractor shall furnish a certification before acceptance and delivery of vehicles that the powertrain as being designed, manufactured, and installed in accordance with the powertrain manufacturer's requirements.

Special Tools and Equipment for-Powertrain Diagnostics and Maintenance

Proposer should provide a complete listing of All Special Tools and Equipment required for Powertrain Diagnostics and Maintenance with the Bid Submittal.

Each set of Special Tools and Equipment for Powertrain Diagnostics and Maintenance as a minimum shall include a laptop computer, software licenses to support engine diagnostics, and access to the online Technical Support for the twelve (12) years life of the buses. The contractor should submit a detailed description of the laptop computer, software licensing and online Technical Support to DTPW with the proposal.

Sets of Special Tools and Equipment required for Powertrain Diagnostics and Maintenance should be priced separately from the bus in the Price Proposal. DTPW shall have the option to purchase up to twenty (20) Sets of Special Tools and Equipment Required for powertrain diagnostics and maintenance.

Spare Powertrain

Spare Powertrain shall be provided by the Contractor and should be priced separately from the bus in the Price Proposal. DTPW shall have the option to purchase up to thirty (30) Spare Powertrain.

Special Training by Powertrain Manufacturer

Contractor shall provide special Powertrain Training to be conducted by the Powertrain Manufacturer at DTPW or a local facility in South Florida. This special training shall be more in-depth and detailed than the training provided by the bus manufacturer. Training shall include comprehensive diagnostics and repair of the engine system components emissions systems. The Contractor should provide a complete description of the Powertrain Manufacturer's training program with the proposal. Training classes shall consist of no more than (20) trainees per class.

Special Training Required to Maintain the Powertrain shall be priced separately from the bus and from other specified training in the Price Proposal. DTPW shall have the option to purchase training for up to 50 trainees.

Special Tools and Equipment for Cradle or Powertrain Changes

The Proposer should provide a list of special tools and equipment required for cradle or powertrain changes with his proposal. Sets of Special Tools and Equipment required for Cradle or Powertrain Changes should be provided by the Contractor and priced separately from the bus in the Price Proposal. DTPW shall have the option to purchase up to five (5) Sets of Special Tools and Equipment required for Cradle or Powertrain Changes.

TS 9.1. Shop/Depot Charging Connection

The bus shall able to interface and receive a charge from shop/depot charging equipment with a minimum charge rate of 100 kW in order to provide a quick full charging of the ESS in approximately 2 hours. The shop/depot charger connection interface shall be located next to the fuse box on the rear curbside of the bus. The charger interface shall have its own access door.

TS 10. Cooling Systems

The cooling systems shall be of sufficient size to maintain all motor, power electronics and traction batteries at safe continuous operating temperatures during the most severe operations and conditions possible and in accordance with battery and drive system component manufacturers' cooling system requirements and recommendations. The cooling system fan/fans control should sense the temperatures of the operating fluids and intake air and if either is above recommended operating conditions the cooling fan should be engaged. The fan control system shall be designed with a fail-safe mode of "fan on." The cooling system shall have an ambient capacity of at least 120° F with water as coolant at sea level operation.

Operation of required battery thermal management systems shall be automatically controlled under all normally encountered operating and charging conditions and shall be powered by an onboard source at all times. Thermal management shall be continuously monitored during all periods of charge and discharge with appropriate safety interlocks installed to react to adverse conditions as stated in SAE-J1772.

Air intakes shall be properly positioned and configured to minimize the intake of water, road dust, and debris and shall be adequately filtered.

In the event of a failure of the battery thermal management system while charging, the charge system shall be disabled and a visual alert shall be activated on the dashboard, the reset of which shall require the deliberate action of maintenance personnel. In the event of a failure of the battery thermal management system during bus operation, an audible and visual alert shall be activated on the dashboard, the reset of which shall require the deliberate action of maintenance personnel. In the event of a fire onboard a bus, thermal management fans shall be automatically turned off.

A complete description of the battery thermal management systems shall accompany the bid package. Written confirmation from the battery manufacturer attesting to the suitability of the battery thermal management system shall be submitted to the Procuring Agency concurrent with or prior to delivery of the first bus.

The cooling system fan controls should sense the temperatures of the operating fluids and the intake air, and if either is above safe operating conditions, the cooling fan should be engaged. The fan control system shall be designed with a fail-safe mode of "fan on." The cooling system shall meet the requirements stated in Operating Environment, Section 5.7 above. The cooling system is assumed for all temperature control required for the propulsion system, heating and/or cooling, further assuming that heat from this system will also be used to provide thermal energy as required for vehicle functions, as HVAC and defroster. Coolant shall be filtered by an inhibitor free spin-on replaceable filter, further serviced by two quarter turn shut-off valves for ease of replacement. The approved coolant/antifreeze shall have properties equivalent to Texaco Extended Life Prediluted 50/50 Coolant/ Anti-Freeze (Code 7998).

TS 10.1 Motor Cooling

Motor temperature sensors shall be easily accessible for replacement. Motor temperature sensors shall not disable the bus at any time.

Motor cooling fans shall be of durable corrosion-resistant construction, bolted-on and designed so a mechanic can gain access, remove and replace fan in fifteen minutes or less. The cooling fan and mounting bracket shall be designed to withstand thermal fatigue and vibration associated with the installed configuration.

The cooling fan shall be temperature controlled, operating only when the motor has reached the manufacturer's maximum allowable temperature.

TS 10.2 Charge Air Cooling

Not Applicable

TS 10.3 Transmission Cooling

The transmission (if required) shall be cooled in order to maintain operating fluids within the transmission manufacturer's recommended parameters of flow, pressure and temperature. The cooling system shall be able to cool the transmission while operating continuously at highway speeds.

TS 10.4 Electric Drive System Cooling

Thermal management system shall maintain electric drive system components within design operating temperature limits in all driving conditions.

TS 11. Transmission (if required)

If multiple speed, the transmission shall be automatic shift with torque converter, retarder and electronic controls. Gross input power, gross input torque and rated input speed shall be compatible with the propulsion system. The transmission shall be designed to operate for not less than 300,000 miles on the design operating profile without replacement or major service. The transmission should be easily removable without disturbing the propulsion system and accessible for service.

The electronic controls shall be capable of transmitting and receiving electronic inputs and data from other drivetrain components and broadcasting that data to other vehicle systems. Communication between electronic drivetrain components and other vehicle systems shall be made using the communications networks. Electronic controls shall be compatible with either 12- or 24-volt power distribution, provide consistent shift quality and compensate for changing conditions such as variations in vehicle weight and engine power.

A nominal brake pedal application of 6 to 10 psi shall be required by the driver to engage forward or reverse range from the neutral position to prevent sudden acceleration of the bus from a parked position.

The electronically controlled transmission shall have on-board diagnostic capabilities, be able to monitor functions, store and time stamp out-of-parameter conditions in memory, and communicate faults and vital conditions to service personnel. The transmission shall contain built-in protection software to guard against severe damage. The on-board diagnostic system shall trigger a visual alarm to the driver when the electronic control unit detects a malfunction.

An electronic transmission fluid level monitoring and protection system shall be provided.

Transmission filler tube and dipstick shall be accessible from the engine compartment

A remote mounted fluid sampling port (KP Series Pushbutton Sampling Valve) for the transmission shall be provided.

Automatic Neutral Function with Manual Re-engagement

The transmission shall automatically shift to neutral whenever the door brake interlock is applied for five minutes. The driver shall be required to apply the service brake to re-engage forward range.

The drive unit installation shall be certified in writing by the vehicle manufacturer as being designed, manufactured, and installed in accordance with the transmission manufacturer's requirements before acceptance and delivery of vehicles.

Documentation proving that the pilot bus or first production bus (if no pilot bus available) meets or exceed the transmission manufacturer's cooling requirements shall be provided by the bus manufacturer.

If an Allison Drive is provided the unit shall come equipped with Allison TranSynd synthetic fluid (Ref. TES-295)

Special Tools and Equipment for Transmission Diagnostics and Maintenance

Proposer should provide a complete listing of "All Special Tools and Equipment required for Transmission Diagnostics and Maintenance" with the Bid Submittal.

Special Tools are defined as any wrenches, sockets, transmission unit stands, adaptors, computers, software, diagnostic readers, diagnostic cards and cables needed for connecting to all the related systems utilized on the bus.

Sets of Special Tools and Equipment for Transmission Diagnostics and Maintenance should be priced separately from the bus in the Price Proposal. DTPW shall have the option to purchase up to ten (10) Sets of Special Tools for Transmission Diagnostics and Maintenance.

TS 12. Retarder Regenerative Braking

TS 12.1 Regenerative Braking

The powertrain shall be equipped with regenerative braking designed to improve energy efficiency and extend brake lining service life. The application of regenerative braking shall cause a smooth blending of both regenerative and service brake function.

Actuation of ABS and/or automatic traction control (ATC) shall override the operation of the regenerative brake.

The system shall be designed whereby increasing the pressure on the brake pedal increases the amount of regenerative capability up until a preset point is reached within the brake pedal travel whereby the mechanical brake is engaged. Regenerative braking shall continue to operate during mechanical braking.

The regenerative braking shall be adjustable within the limits of the powertrain and activated when the brake pedal is depressed or upon release of accelerator pedal.

TS 12.2 Braking Resistors

The system shall include a means of maintaining dynamic braking (braking retardation) as the energy storage system approaches 100% SOC, i.e., such as the use of braking resistors to prevent overcharging of the batteries. This same feature may be a component of the overall liquid cooling system loop and offer a means of supplementing heat for use at the main HVAC heater core and/or defroster.

TS 13. Mounting

All powerplant mounting shall be mechanically isolated to minimize transfer of vibration to the body structure and provide a minimum clearance of 0.75 in. Mounts shall control the movement of the powerplant so as not to affect performance of belt-driven accessories or cause strain in piping and wiring connections to the powerplant.

TS 13.1 Service

The propulsion system shall be arranged for ease of access and maintenance. The Contractor shall list all special tools, fixtures or facility requirements recommended for servicing. All components requiring service or replacement shall be easily removable.

Radiator filler caps shall be hinged to the filler neck and closed with spring pressure or positive locks to prevent leakage. All other fluid filler caps shall be hinged or tethered to ensure the filler is closed when filling is completed. that All fluid fill locations shall be properly labeled to help ensure that correct fluid is added. All fillers shall be easily accessible with standard funnels, pour spouts and automatic dispensing equipment. All lubricant sumps shall be fitted with magnetic-type drain plugs.

Final configuration of the propulsion system compartments shall be subject to DTPW approval.

TS 14. Hydraulic Systems

Hydraulic system service tasks shall be minimized and scheduled no more frequently than those of other major coach systems. All elements of the hydraulic system shall be easily accessible for service or unit replacement. Critical points in the hydraulic system shall be fitted with service ports so that portable diagnostic equipment may be connected or sensors for an off-board diagnostic system permanently attached to monitor system operation when applicable. A tamper-proof priority system shall prevent the loss of power steering during operation of the bus if other devices are also powered by the hydraulic system.

The hydraulic system shall operate within the allowable temperature range as specified by the lubricant manufacturer.

Sensors in the main hydraulic system shall indicate on the driver's on-board diagnostic panel conditions of low hydraulic fluid level.

A remote mounted fluid sampling port (KP Series Pushbutton Sampling Valve) for the hydraulic system shall be provided.

Diagnostic ports to check the steering system hydraulic pressure shall be provided.

Liquid Tape shall be applied to all pressure and fluid level sensors/switches exposed to water located at various sections of the bus.

Hydraulic lines shall be compatible with the fluid they carry. The lines shall be designed and intended for use in the environment which they are installed. Lines shall be capable of withstanding maximum system pressures and temperatures. Lines within the engine compartment shall be composed of steel tubing where practicable except in locations where flexible lines are specifically required. All hydraulic lines shall meet the requirements of the Technical Specifications.

The oil for hydraulic system shall be Transynd or approved equal.

Sight glass on hydraulic reservoir shall be provided to determine the level of hydraulic fluid in the reservoir.

TS 14.1 Fluid Lines

All lines shall be rigidly supported to prevent chafing damage, fatigue failures, degradation and tension strain. Lines should be sufficiently flexible to minimize mechanical loads on the components. Lines passing through a panel, frame or bulkhead shall be protected by grommets (or similar devices) that fit snugly to both the line and the perimeter of the hole that the line passes through to prevent chafing and wear. Pipes and fluid hoses shall not be bundled with or used to support electrical wire harnesses.

Lines shall be as short as practicable and shall be routed or shielded so that failure of a line shall not allow the contents to spray or drain onto any component operable above the auto-ignition temperature of the fluid.

All hoses, pipes, lines and fittings shall be specified and installed per the manufacturer's recommendations.

TS 14.2 Fittings and Clamps

All clamps shall maintain a constant tension at all times, expanding and contracting with the line in response to temperature changes and aging of the line material. The lines shall be designed for use in the environment where they are installed. For example, high-temperature resistant in the engine compartment, resistant to road salts near the road surface, and so on. All hoses shall be supported approximately every 12 in.

Compression fittings shall be standardized to prevent the intermixing of components. Compression fitting components from more than one manufacturer shall not be mixed, even if the components are known to be interchangeable.

TS 15. Radiator

If equipped with a radiator system, the radiator piping shall be stainless steel or brass tubing and, if practicable, hoses shall be eliminated. All hoses shall be as short as practicable. Necessary hoses shall be impervious to all bus fluids. All coolant hoses shall be 4-ply silicone rubber or Gates blue strip hoses and the coolant hose clamps shall be stainless steel constant torque clamps.. The clamps shall provide a complete 360-degree seal maintaining a constant tension at all the times, expanding and contracting with the hose in response to temperature changes and aging of the hose material.

TS 16. Oil and Hydraulic Lines

Oil and hydraulic lines shall be compatible with the substances they carry. The lines shall be designed and intended for use in the environment where they are installed. For example, high–temperature resistant in the engine compartment, resistant to road salts near the road surface, and so on. Lines within the engine compartment shall be composed of steel tubing where practicable, except in locations where flexible lines are required.

Hydraulic lines of the same size and with the same fittings as those on other piping systems of the bus, but not interchangeable, shall be tagged or marked for use on the hydraulic system only.

Protective sleeves (high temperature resistant material) shall be provided to all high pressure hydraulic lines for hydraulic pump and power steering.

STRUCTURE

TS 17. General

TS 17.1 Design

The structure of the bus shall be designed to withstand the transit service conditions typical of an urban duty cycle throughout its service life. The vehicle structural frame shall be designed to operate with minimal maintenance throughout the 12-year design operating profile.

TS 18. Altoona Testing

Prior to acceptance of first bus, the structure of the bus shall have undergone appropriate structural testing and/or analysis, including FTA required Altoona testing, to ensure adequacy of design for the urban transit service. Any items that required repeated repairs or replacement must undergo the corrective action with supporting test and analysis. A report clearly describing and explaining the failure and corrective actions taken to

ensure any and all such failures will not occur shall be submitted to DTPW with the proposal technical submittals. If not available, then the report shall be provided prior to first acceptance of bus.

TS 18.1 Structural Validation

Detailed Structural Analysis
The structure of the proposed bus model shall have undergone structural testing prior to assembly of the first bus. The OEM shall provide the Agency with completed reports of other structural tests as specified by the Agency.

TS 19. Distortion

The bus, loaded to GVWR and under static conditions, shall not exhibit deflection or deformation that impairs the operation of the steering mechanism, doors, windows, passenger escape mechanisms or service doors. Static conditions shall include the vehicle at rest with any one wheel or dual set of wheels on a 6 in. curb or in a 6 in. deep hole or with any one tire or any dual set completely deflated.

TS 20. Resonance and Vibration

All structure, body and panel-bending mode frequencies, including vertical, lateral and torsional modes, shall be sufficiently removed from all primary excitation frequencies to minimize audible, visible or sensible resonant vibrations during normal service.

TS 20.1 Engine Compartment Bulkheads

The passenger and engine compartment shall be separated by fire-resistant bulkheads. The engine compartment shall include areas where the motor and transmission are housed. This bulkhead shall preclude or retard propagation of an engine compartment fire into the passenger compartment and shall be in accordance with the Recommended Fire Safety Practices defined in FTA Docket 90A, dated October 20, 1993. Only necessary openings shall be allowed in the bulkhead, and these shall be fire-resistant. Any passageways for the climate control system air shall be separated from the engine compartment by fire-resistant material. Piping through the bulkhead shall have fire-resistant fittings sealed at the bulkhead. Wiring may pass through the bulkhead only if connectors or other means are provided to prevent or retard fire propagation through the bulkhead. Engine compartment access panels in the bulkhead shall be fabricated of fire-resistant material and secured with fire-resistant fasteners. These panels, their fasteners and the bulkhead shall be constructed and reinforced to minimize warping of the panels during a fire that will compromise the integrity of the bulkhead.

TS 20.2 Crashworthiness

The bus body and roof structure shall withstand a static load equal to 150 percent of the curb weight evenly distributed on the roof with no more than a 6 in. reduction in any interior dimension. Windows shall remain in place and shall not open under such a load. These requirements must be met without the roof-mounted equipment installed.

The bus shall withstand a 25 mph impact by a 4000-pound automobile at any side, excluding doorways, along either side of the bus with no more than 3 in. of permanent structural deformation at seated passenger hip height. This impact shall not result in sharp edges or protrusions in the bus interior.

Exterior panels below 35 in. from ground level shall withstand a static load of 2000 lbs applied perpendicular to the bus by a pad no larger than 5 sq in. This load shall not result in deformation that prevents installation of new exterior panels to restore the original appearance of the bus.

Test reports or detailed engineering reports validating the crashworthiness shall be provided prior to assembly of the first bus. If a Finite Element Analysis FEA is provided as proof of crashworthiness for the proposed vehicle, it must include a qualified engineering analysis and report for crashworthiness.

TS 21. Corrosion

The bus shall not corrode from atmospheric conditions and road salts. The bus shall be constructed using only inherently corrosion-resistant materials and fasteners to minimize deterioration. The structure shall not require corrosion-preventive coatings or after-treatments either during construction or throughout the service life of the vehicle. It shall maintain structural integrity and maintain original appearance throughout its service life, provided it is maintained in accordance with the procedures specified in the Contractor's service manual. All joints and connections of dissimilar metals shall be corrosion-resistant and shall be protected from galvanic corrosion. Representative samples of all materials and connections shall withstand a 2-week salt spray test in accordance with ASTM Procedure B-117 with no visual or structural detrimental effects to normally visible surfaces, and no significant structural degradation or weight loss of over 1 percent for other members or components. An anticorrosion undercoat shall be applied under the floor area and other areas requiring greater protection. The Contractor should submit a corrosion protection plan with approved equal submissions.

TS 22. Towing

Towing devices shall be provided on each end of the bus. Each towing device shall withstand, without permanent deformation, tension loads up to 1.2 times the curb weight of the bus within 20 degrees of the longitudinal axis of the bus. If applicable, the rear towing device(s) shall not provide a toehold for unauthorized riders. The method of attaching the towing device shall not require the removal, or disconnection, of front suspension or steering components. Removal of the bike rack is permitted for attachment of towing devices. Towing shall be accomplished by front lift towing.

The front towing devices shall allow attachment of adapters for a rigid tow bar and shall permit the lifting and towing of the bus, at curb weight, while the front wheels are clear off the ground. These devices shall also permit common flat towing. Two (2) front towing adapters shall be provided with each bus.

The rear towing device shall permit recovery of the bus for a short distance, such as in cases of emergency, to allow access to provisions for front towing of the bus. The rear towing shall withstand the associated loads without deformation or damage to the vehicle structure. The method of attaching the tow bar or adapter shall require the specific approval of DTPW. Each towing device shall accommodate a crane hook with a 1 in. throat.

A plug connector permanently mounted at the front of the bus shall provide for bus tail lamp, marker, stop, and turn signal lamp operation as controlled from the towing vehicle. The connector shall include a spring-loaded, dust- and water-resistant cap.

The towing procedure shall not require removal of any access doors. If a drive shaft or other under floor component is required to be removed for towing, access through the bus floor shall be provided. The towing system shall also be designed so as to no interfere with other bus components. Provisions shall include an air connection at the front and rear of the bus for supply of air to maintain air in the system. The method of attaching the tow bar shall require the specific approval of DTPW. The Contractor should submit the towing procedure with the Requests for Approved Equal submissions and shall demonstrate compliance with the towing procedure at DTPW facility using the Pilot Bus or first delivered bus before the final acceptance.

Universal Tow Bar

Universal tow bar for conventional and articulated bus BCW Model UTB-1000 or approved equal shall be provided by the Contractor and priced separately from the bus in the Price Proposal. DTPW shall have the option to purchase up to six (6) Universal tow bars.

The universal tow bar, including demonstration, shall be provided to DTPW with the Pilot Bus or before the final acceptance of the first delivered bus for DTPW approval.

TS 23. Jacking

It shall be possible to safely jack up the bus, at curb weight, with a common 10-ton floor jack with or without special adapter, when a tire or dual set is completely flat and the bus is on a level, hard surface, without crawling under any portion of the bus. Jacking from a single point shall permit raising the bus sufficiently high to remove and reinstall a wheel and tire assembly. Jacking pads located on the axle or suspension near the wheels shall permit easy and safe jacking with the flat tire or dual set on a 6 in. high run-up block not wider than a single tire. The bus shall withstand such jacking at any one or any combination of wheel locations without permanent deformation or damage.

Jacking pads shall be painted safety yellow for easy identification.

TS 24. Hoisting

The bus axles or jacking plates shall accommodate the lifting pads of a two-post hoist system. Jacking plates, if used as hoisting pads, shall be designed to prevent the bus from falling off the hoist. Other pads or the bus structure shall support the bus on jack stands independent of the hoist. All jacking points/plates shall be identified and approved by DTPW.

TS 25. Floor

TS 25.1 Design

The floor shall be essentially a continuous plane, except at the wheel housings and platforms. Where the floor meets the walls of the bus, as well as other vertical surfaces such as platform risers, the surface edges shall be blended with a circular section of radius not less than ¼ in. or installed in a fully sealed butt joint. Similarly, a molding or cover shall prevent debris accumulation between the floor and wheel housings. The vehicle floor in the area of the entrance and exit doors shall have a lateral slope not exceeding 2 degrees to allow for drainage.

The floor height above the street in the aisle near the entry door, except for platforms, shall be no more than 15½ inches to eliminate steps and facilitate boarding and de-boarding of passengers.

The floor may be either a bi-level design or a flat/sloped floor design.

The bi-level design shall consist of two levels; a forward lower level that includes the entrance door area and an aft raised level extending to the rear settee riser. The forward lower level floor may be inclined up to 1½ degrees off the horizontal along the longitudinal axis of the bus. The aft upper level floor height may be raised to a height approximately 18 inches above the lower level. The upper level floor shall be allowed an increased slope not to exceed 3½ degrees off the horizontal.

The flat/sloped floor design shall consist of a single low sloped floor. The forward portion of the floor including the entrance door area may be inclined up to 1½ degrees off the horizontal along the longitudinal axis of the bus. The aft portion of the floor, beginning approximately two-thirds of the aisle length aft of the entry door and extending to the rear settee riser, the floor may be sloped but shall not exceed 5½ degrees off the horizontal.

All floor measurements have to be with the bus at the design ride height and on a flat, level surface.

The floor shall not have any abrupt level changes except for clearly marked and illuminated steps as described in these Technical Specifications.

The floor in the area of the entrance door shall have proper drainage.

Access openings in the floor shall be sealed to prevent entry of fumes and water into the bus interior. Access covers shall be flush with the floor and floor covering material shall be edge-bound with stainless steel or anodized aluminum to prevent the edges from coming loose. Fasteners shall tighten flush with the floor.

TS 25.2 Strength

The floor shall be designed to last the life of the bus. The floor deck may be integral with the basic structure or mounted on the structure securely to prevent chafing or horizontal movement and designed to last the life of the bus. Sheet metal screws shall not be used to retain the floor, and all floor fasteners shall be serviceable from one side only. Any adhesives, bolts or screws used to secure the floor to the structure shall last and remain effective throughout the life of the coach. Tapping plates, if used for the floor fasteners, shall be no less than the same thickness as a standard nut, and all floor fasteners shall be secured and protected from corrosion for the service life of the bus.

The floor deck shall be reinforced as needed to support passenger loads. At GVWR, the floor shall have an elastic deflection of no more than 0.60 in. from the normal plane. The floor shall withstand the application of 2.5 times gross load weight without permanent detrimental deformation. The floor, with coverings applied, shall withstand a static load of at least 150 lbs applied through the flat end of a ½ in. diameter rod, with 1/32-inch radius, without permanent visible deformation.

TS 25.3 Construction

The floor shall consist of the subfloor and the floor covering that will last the life of the bus. The floor as assembled, including the sealer, attachments and covering, shall be waterproof, non-hygroscopic and resistant to mold growth. The subfloor shall be resistant to the effects of moisture, including decay (dry rot). It shall be impervious to wood-destroying insects such as termites.

If composite flooring is used, the material must be approved by DTPW.

If plywood is used, it shall be certified at the time of manufacturing by an industry approved third-party inspection agency such as APA - The Engineered Wood Association (formerly the American Plywood Association). Plywood shall be ¾ inch thick or of a thickness adequate to support the design loads, manufactured with exterior glue, satisfy the requirements of a Group I Western panel as defined in PS 1-95 (Voluntary Product Standard PS 1-95, Construction and Industrial Plywood) and be of a grade that is manufactured with a solid face and back. Plywood shall be installed with the highest-grade veneer up. Plywood flooring shall be Alkaline Copper Quaternary (ACQ) pressure treated with preservative retention of .40 lbs./ft.^{3}, kiln dried after treatment (KDAT). The treated wood shall conform to the standards set forth by the American Wood Preservers Association (AWPA) and the American Lumber Standards Committee (ALSC). The concentration of preservative chemical shall be equal to or greater than required for ground contact application. Treated plywood will be certified for preservative penetration and retention by a third party inspection agency. Preservative treatments shall utilize no EPA listed hazardous chemicals. Pressure-preservative treated plywood shall have a moisture content at or below fifteen percent. Provide a consumer information sheet for the plywood product to include handling precautions with Requests for Approved Equals submittals.

ACQ pressure treated plywood must not contact steel, galvanized steel, or aluminum body or chassis parts.

All plywood edges shall be sealed, including any edges of cutouts in the floor for mounting special equipment.

Under floor treatment shall be installed to prevent contact of plywood panels by water and road salt.

TS 26. Platforms

TS 26.1 Driver's Area

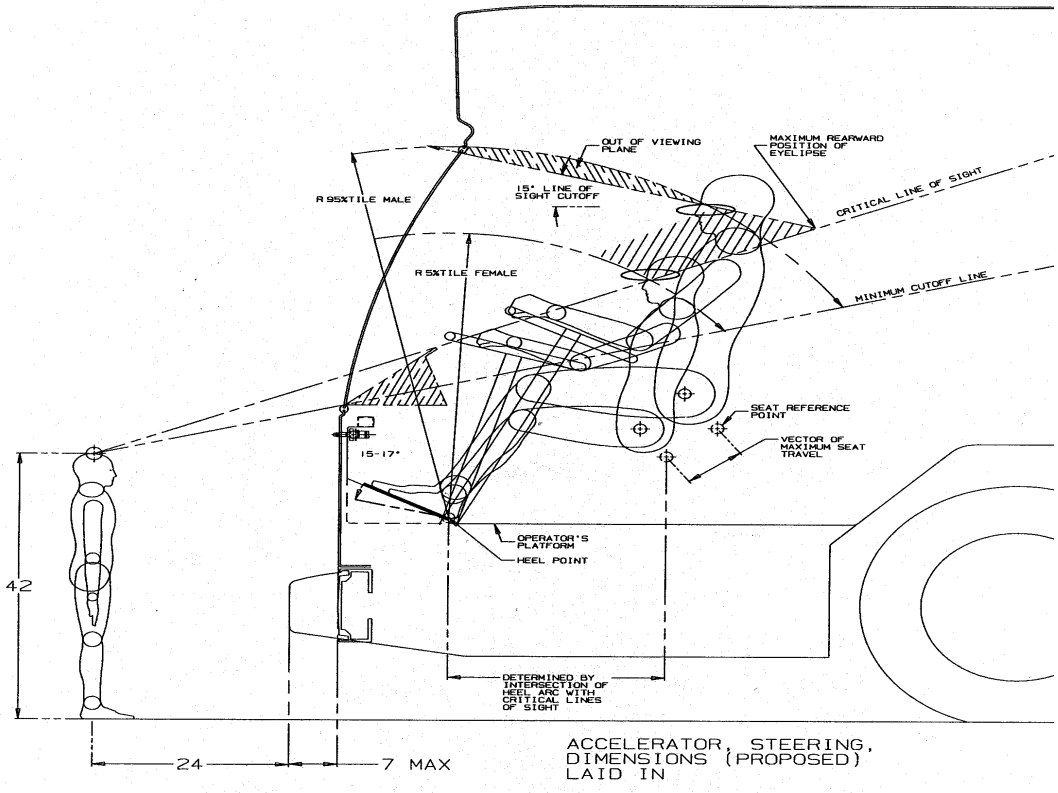
Trim shall be provided along top edges of platforms unless integral nosing is provided. Trim installed along edges of platforms shall be constructed of stainless steel or clear anodized aluminum. Except where otherwise indicated, covering of platform surfaces and risers shall be same material as specified for floor covering.

Raised areas such as for providing space for under-floor installation of components shall be limited. Such raised areas shall be constructed in accordance to these specifications.

TS 26.2 Driver's Platform

The driver's platform shall be of a height such that, in a seated position, the driver can see an object located at an elevation of 42 in. above the road surface, 24 in. from the leading edge of the bumper. Notwithstanding this requirement, the platform height shall not position the driver such that the driver's vertical upward view is less than 15 degrees. A warning decal or sign shall be provided to alert the driver to the change in floor level. Figure below illustrates a means by which the platform height can be determined, using the critical line of sight.

Determining Platform Height



TS 26.3 Farebox

If the driver's platform is higher than 12 inches, then the farebox is to be mounted on platform of suitable height to provide accessibility for operator without compromising passenger's access. Stainless steel stanchions and grab rails shall be located around the farebox.

TS 26.4 Rear Step Area to Rear Area

If the vehicle is of a bi-level floor design, a rear step area shall be provided along the center aisle of the bus to facilitate passenger traffic between the upper and lower floor levels. This step area shall be cut into the rear platform and shall be approximately the aisle width, a minimum 12 in. deep and approximately half the height of the upper level relative to the lower level. The horizontal surface of this platform shall be covered with skid-resistant material with a visually contrasting nosing and shall be sloped slightly for drainage. A warning decal or sign shall be provided at the immediate platform area to alert passengers to the change in floor level.

Stepwells shall be constructed of stainless steel or anodized aluminum to prevent corrosion. One piece molded fiberglass construction will be accepted provided that it is shown to be adequately reinforced to eliminate step deflection and warranted to last the life of the bus. Step risers shall not exceed 10 inches in height and tread surface shall be no less than 11 inches deep. All step tread areas must be covered with a non-slip material. Proposer must state which stepwell described above will be furnished. Proposers proposing to utilize stepwells constructed of fiberglass must submit documentation to DTPW for approval on strength, structural integrity and suitability for use in DTPW's service area.

There shall be no entry or exit stepwells.

TS 27. Wheel Housing

TS 27.1 Design and Construction

Sufficient clearance and air circulation shall be provided around the tires, wheels and brakes to preclude overheating when the bus is operating on the design operating profile. Wheel housings shall be constructed of corrosion-resistant and fire-resistant material.

Interference between the tires and any portion of the bus shall not be possible in maneuvers up to the limit of tire adhesion with weights from curb weight to GVWR. Wheel housings shall be adequately reinforced where seat pedestals are installed. Wheel housings shall have sufficient sound insulation to minimize tire and road noise and meet all noise requirements of this specification.

Design and construction of front wheel housings shall allow for the installation of a radio or electronic equipment storage compartment on the interior top surface, or its use as a luggage rack.

The finish of the front wheel housings shall be scratch-resistant and complement interior finishes of the bus to minimize the visual impact of the wheel housing. If fiberglass wheel housings are provided, then they shall be color-impregnated to match interior finishes. The lower portion extending to approximately 10 to 12 in. above floor shall be equipped with scuff-resistant coating or stainless steel trim.

Wheel housings, as installed and trimmed, shall withstand impacts of a 2 in. steel ball with at least 200 ft-lbs of energy without penetration.

Wheel housings not equipped with seats or equipment enclosure shall have a horizontal assist mounted on the top portion of the housing no more than 4 in. higher than the wheel well housing.

All wheelhouse corners must be rounded. No sharp corners will be accepted.

CHASSIS

TS 28. Suspension

TS 28.1 General Requirements

The front and rear suspensions shall be pneumatic type. The basic suspension system shall last the service life of the bus without major overhaul or replacement. Adjustment points shall be minimized and shall not be subject to a loss of adjustment in service. Routine adjustments shall be easily accomplished by limiting the removal or disconnecting the components.

The suspension system shall include provisions for stabilizing and damping so as to produce an acceptable ride quality. The air suspension shall act to keep the floor height nearly constant under all load conditions.

At least two (2) air springs shall be provided per axle, with heavy duty hydraulic shock absorbers on each side of each axle. Radius rods and other stabilizing devices shall be provided as necessary at the axles to control lateral, longitudinal and torsional movement of the suspension system.

All suspension components shall be of heavy duty design because the bus may be required to operate on uneven surface conditions.

TS 28.2 Alignment

All axles should be properly aligned so the vehicle tracks accurately within the size and geometry of the vehicle.

TS 28.3 Springs and Shock Absorbers

TS 28.3.1 Suspension Travel

The suspension system shall permit a minimum wheel travel of 2.75 in. jounce-upward travel of a wheel when the bus hits a bump (higher than street surface), and 2.75 in. rebound-downward travel when the bus comes off a bump and the wheels fall relative to the body. Elastomeric bumpers shall be provided at the limit of jounce travel. Rebound travel may be limited by elastomeric bumpers or hydraulically within the shock absorbers. Suspensions shall incorporate appropriate devices for automatic height control so that regardless of load the bus height relative to the centerline of the wheels does not change more than ½ in. at any point from the height required. The safe operation of a bus cannot be impacted by ride height up to 1 in. from design normal ride height.

TS 28.3.2 Damping

Vertical damping of the suspension system shall be accomplished by hydraulic shock absorbers mounted to the suspension arms or axles and attached to an appropriate location on the chassis. Damping shall be sufficient to control coach motion to three cycles or less after hitting road perturbations. The shock absorber bushing shall be made of elastomeric material that will last the life of the shock absorber. The damper shall incorporate a secondary hydraulic rebound stop.

TS 28.3.3 Lubrication

All elements of steering, suspension, and drive systems requiring scheduled lubrication shall be provided with grease fittings conforming to SAE Standard J534. These fittings shall be located for ease of inspection, and shall be accessible with a standard grease gun without flexible hose end from a pit or with the bus on a hoist. Each element requiring lubrication shall have its own grease fitting with a relief path. Lubricant specified shall be standard for all elements on the bus serviced by standard fittings. The lubricant specified shall be standard for all elements on the bus serviced by standard fittings and shall be required no less than every 6000 miles.

TS 28.3.4 Kneeling

A kneeling system controlled by the driver shall lower the bus entrance a minimum of two and one half (2.5) inches, measured at the longitudinal center line of the front door, during loading or unloading operations regardless of load up to GVWR. Release of the kneeling control switch at anytime will completely stop the lowering motion and hold height of the bus at that position. Brake and throttle interlock shall prevent bus movement when the bus is kneeled. The kneeling control shall be disabled when the bus is in motion. The bus shall be capable of kneeling in a maximum of 5 seconds from time the control is actuated. After kneeling, the bus shall be capable of rising within 2 seconds to a height permitting the bus to resume service and shall rise to the correct operating height within 7 seconds regardless of load up to GVWR. Selecting the “Ride Height” position will allow the system to raise the floor to normal ride height without the driver having to hold the switch. During the lowering and raising operation, the maximum acceleration shall not exceed 0.2g and the jerk shall not exceed

0.3g/ sec. measured on the front door step tread. The time to kneel and rise shall be adjustable from outside the bus, and shall require only hand tools.

An indicator visible to the driver shall be illuminated during the kneeling operation and shall remain illuminated until the bus is raised to a height adequate for safe street travel. An audible warning alarm will sound simultaneously with the operation of the kneeling system to alert passengers and bystanders. The audible warning alarm will stop when the bus has reached the kneeled position. An external LED warning light with an amber lens mounted near the entrance door will be provided. It shall flash when the kneel feature is operating. Kneeling shall not be operational while the wheelchair ramp is deployed or in operation.

TS 29. Wheels and Tires

TS 29.1 Wheels

All wheels shall be removable without a puller. Wheels shall be compatible with tires in size and load-carrying capacity. Front wheels and tires shall be balanced as an assembly per SAE J1986.

Wheels shall be hub-piloted, brushed aluminum, and shall resist rim flange wear. Wheels shall have a low maintenance special finish, Alcoa Dura-Bright, Accuride Accu-Shield, or approved equal. Wheels shall be suitable for tubeless type tires and shall be compatible with tire size and tire load-carrying capacity. Wheels and tires shall be balanced as an assembly.

Spare Wheels

One spare wheel per bus shall be provided by the Contractor and shall be included in the bus price. DTPW shall have the option to purchase up to 250 spare wheels to be priced separately from the bus in the Price Proposal.

A tire pressure monitoring system shall be provided. A description of the system shall be provided to DTPW with the proposal for approval. All equipment location, accessibility, and mounting, shall be approved by DTPW prior to production.

TS 29.2 Tires

Tires shall be suitable for the conditions of transit service and sustained operation at the maximum speed capability of the bus. The tire size shall be compatible with the wheels, and of a load range adequate for the gross vehicle weight rating of the bus. Load on any tire at GVWR shall not exceed tire supplier's rating. All valve stems shall be readily accessible on the side of the bus for servicing and maintenance.

All tires will be provided under a lease agreement between DTPW and the tire supplier at no cost to the bus manufacturer.

TS 30. Steering

An electrically driven power steering hydraulic pump shall be provided. Hydraulically assisted steering shall be provided to reduce steering effort.

Protective sleeves (high temperature resistant material) shall be provided to all high pressure hydraulic lines for power steering.

TS 30.1 Steering Axle

The front axle shall be solid beam (or approved equal), non-driving with a load rating sufficient for the bus loaded to GVWR and shall be equipped with grease type front wheel bearings and seals.

All friction points on the front axle shall be equipped with replaceable bushings or inserts and, if needed, lubrication fittings easily accessible from a pit or hoist.

TS 30.2 Wheel

TS 30.2.1 Turning Effort

Steering effort shall be measured with the bus at GVWR, stopped with the brakes released and the engine at normal idling speed on clean, dry, level, commercial asphalt pavement and the tires inflated to recommended pressure.

Under these conditions, the torque required to turn the steering wheel 10 degrees shall be no less than 5 ft-lbs and no more than 10 ft-lbs. Steering torque may increase to 70 ft-lbs when the wheels are approaching the steering stops, as the relief valve activates.

Power steering failure shall not result in loss of steering control. With the bus in operation, the steering effort shall not exceed 55 lbs at the steering wheel rim, and perceived free play in the steering system shall not materially increase as a result of power assist failure. Gearing shall require no more than seven turns of the steering wheel lock-to-lock.

Caster angle shall be selected to provide a tendency for the return of the front wheels to the straight position with minimal assistance from the driver.

TS 30.2.2 Steering Wheel, General

The steering wheel diameter shall be approximately 18-20 in.; the rim diameter shall be ⅞ in. to 1¼ in. and shaped for firm grip with comfort for long periods of time.

Steering wheel spokes and wheel thickness shall ensure visibility of the dashboard so that vital instrumentation is clearly visible at center neutral position (within the range of a 95th-percentile male, as described in SAE 1050a, Sections 4.2.2 and 4.2.3). Placement of steering column must be as far forward as possible, but either in line with or behind the instrument cluster.

TS 30.2.3 Steering Column Tilt

The steering column shall have full tilt capability with an adjustment range of no less than 40 degrees from the vertical and easily adjustable by the driver.

TS 30.2.4 Steering Wheel Telescopic Adjustment

The steering wheel shall have full telescoping capability and have a minimum telescopic range of 2 in. and a minimum low-end adjustment of 29 in., measured from the top of the steering wheel rim in the horizontal position to the cab floor at the heel point.

Steering Wheel Height[1] Relative to Angle of Slope

At Minimum Telescopic Height Adjustment (29 in.)		At Maximum Telescopic Height Adjustment (5 in.)	
Angle of Slope	**Height**	**Angle of Slope**	**Height**
0 degrees	29 in.	0 degrees	34 in.
15 degrees	26.2 in.	15 degrees	31.2 in.
25 degrees	24.6 in.	25 degrees	29.6 in.
35 degrees	22.5 in.	35 degrees	27.5 in.

1. Measured from bottom portion closest to driver.

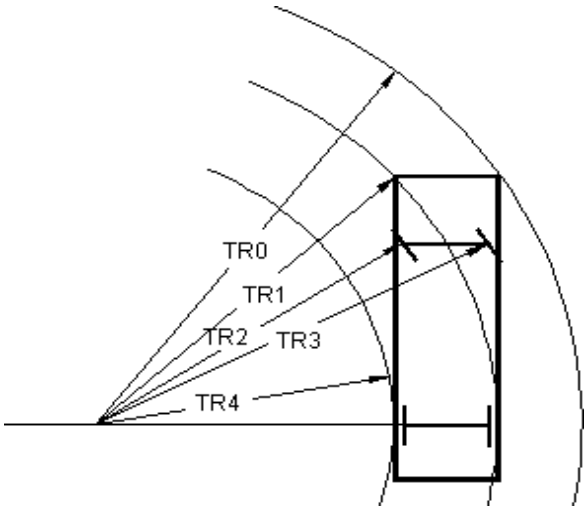
TS 31. Drive Axle

The rear drive axle shall be a heavy-duty axle compatible with synthetic oil and with a load rating sufficient for the bus loaded to GVWR. The axle shall be designed to operate for not less than 300,000 miles on the design operating profile without replacement or major repairs. The axle and driveshaft components shall be rated for both propulsion and retardation modes with respect to duty cycle. The differential gear ratio shall provide a top speed of 60 MPH. Transfer of gear noise to the bus interior shall be minimized. Wheel bearings shall be grease lubricated. Replaceable wheel bearing seals shall run on replaceable wear surfaces or be of an integral wear surface sealed design. The axle breather assembly shall be designed to prevent ingress of water. The drain plug shall be magnetic type.

The drive shaft shall be guarded to prevent hitting any critical systems, including brake lines, coach floor or the ground, in the event of a tube or universal joint failure.

TS 32. Turning Radius

Bus Length (approximate)	Maximum Turning Radius
40 ft.	44 ft. (TR0)



TS 33. Brakes

TS 33.1 Service Brake

Service Brakes shall be disc brake. The braking system shall be the heaviest duty available for the vehicle GVWR and shall be provided with electronic brake monitoring system that includes a brake wear sensor and alarm to notify driver and maintenance of unsafe brake conditions.

TS 33.2 Actuation

Service brakes shall be controlled and actuated by an air system meeting the requirements of FMVSS 121, on the date of manufacture. Force to activate the brake pedal control shall be an essentially linear function of the bus deceleration rate and shall not exceed 50 pounds at a point 7 inches above the heel point of the pedal

to achieve maximum braking. The heel point is the location of the driver's heel when the foot is rested flat on the pedal and the heel is touching the floor or heel pad of the pedal.

A microprocessor controlled Automatic Braking System (ABS) shall be provided. The microprocessor for the ABS system shall be protected yet in an accessible location to allow for ease of service. ABS diagnostic reader port shall be through the J1939 engine diagnostic port.

The total braking effort shall be distributed between all wheels in such a ratio as to ensure maximum tire mileage and equal friction material wear rate at all wheel locations. Manufacturer shall demonstrate compliance by providing a copy of a thermo dynamic brake balance test with the proposal. Microprocessor controlled automatic traction control (ATC) shall be provided.

Actuation of ABS and /or ATC shall override the operation of the brake retarder.

Brake hoses shall be provided with spring guard.

TS 33.3 Friction Material

The entire service brake system, including friction material, shall have a minimum overhaul or replacement life of at least 50,000 miles on the design operating profile. Brakes shall be self-adjusting throughout this period.

The bus shall be equipped with disc brakes on the front and rear axles. The brake pads shall be made of non-asbestos material. In order to aid maintenance personnel in determining extent of wear, a provision to indicate the thickness at which replacement becomes necessary, shall be provided on each brake pad.

TS 33.4 Hubs and Discs

Replaceable wheel bearing seals shall run on replaceable wear surfaces or be of an integral wear surface sealed design. Wheel bearing and hub seals shall not leak or weep lubricant for 100,000 miles when running on the design operating profile.

The bus shall be equipped with disc brakes on all axles, and the brake discs shall allow machining of each side of the disc to obtain smooth surfaces per manufacturer's specifications.

The brake system material and design shall be selected to absorb and dissipate heat quickly so that the heat generated during braking operation does not glaze brake linings. The heat generated shall not increase the temperature of tire beads and wheel contact area to more than that allowed by the tire manufacturer.

TS 33.5 Parking/Emergency Brake

The parking brake shall be a spring-operated system, actuated by a valve that exhausts compressed air to apply the brakes. The parking brake may be manually enabled when the air pressure is at the operating level per FMVSS 121.

An emergency brake release shall be provided to release the brakes in the event of automatic emergency brake application. The driver shall be able to manually depress and hold down the emergency brake release valve to release the brakes and maneuver the bus to safety. Once the driver releases the emergency brake release valve, the brakes shall engage to hold the bus in place. Parking brake control and emergency brake release valves shall be located within easy reach of the driver. The parking brake control valve knob shall be yellow, diamond shaped, with written instructions on the knob. The emergency brake release valve knob shall be green, round shaped, with written instructions on the knob.

Application of the parking brake shall automatically put the bus and/or transmission (if applicable) into neutral range.

The buses shall be programmed to sound an alarm if the ignition is turned off and the park brake is not applied. This will alert the operator to set the park brake because the interlocks do not function with the ignition off. A method for cancellation of the parking brake alarm (for Maintenance use only) shall be provided.

TS 34. Interlocks

TS 34.1 Passenger Door Interlocks

To preclude movement of the bus with the front or rear door(s) open, when the door control is activated an accelerator interlock shall remove throttle control returning the engine to idle speed and a brake interlock shall engage the brakes. The interlocks shall remain on until the door switch is deactivated and the doors are in the fully closed position and a service brake application is made.

Air pressure shall be relieved by means of a quick release air valve to prevent lag in releasing brakes when doors are closed.

The braking effort shall be adjusted to limit deceleration level. The braking effort shall be adjustable with hand tools only. The adjustment device shall be enclosed in tamper proof housing if located inside the bus.

The doors must be wired to a speed sensor so that the interlock cannot be activated and the doors cannot be opened at a speed above 4 mph.

With the master run switch in the off position and the door open, the door, the interlock, and the stop lights must not be energized.

All door systems employing brake and accelerator interlocks shall be supplied with supporting failure mode effects analysis (FEMA) documentation, which demonstrates that failure modes are of a failsafe type, thereby never allowing the possibility of release of interlock while an interlocked door is in and unsecured condition, unless the door master switch has been actuated to intentionally release the interlocks.

A door interlock override switch(s) shall be provided in the front door motor compartment to allow the bus to be moved should the interlock fail to release when the doors are closed.

TS 35. Pneumatic System

TS 35.1 General

The bus air system shall operate the air-powered accessories and the braking system with reserve capacity. New buses shall not leak down more than 5 psi over a 15-minute period of time as indicated on the dash gauge.

Air for the compressor shall be filtered. The air system shall be protected by a pressure relief valve set at 150 psi and shall be equipped with check valves and pressure protection valves to assure partial operation of critical subsystems in case of line failures.

Provision shall be made to apply shop air to the bus air systems. Aeroequip FD 41-1000-06-04 female quick disconnect couplings shall be provided at easily accessible locations in the engine compartment and near the front bumper area for towing. Retained caps shall be installed to protect fittings against dirt and moisture when not in use. A standard tire inflation type Schrader valve shall also be provided in the engine compartment.

Liquid Tape shall be applied to all sensors/switches exposed to water located at various sections of the bus to prevent moisture intrusion.

Test gauge ports for the air system shall be provided.

TS 35.2 Air Compressor

The electrically driven air compressor shall be sized to charge the air system from 40 psi to the governor cut-off pressure in less than 3 minutes.

TS 35.3 Air Lines and Fittings

Air lines, except necessary flexible lines, shall conform to the installation and material requirements of SAE Standard J1149 for copper tubing with standard, brass, flared or ball sleeve fittings, or SAE Standard J844 for nylon tubing if not subject to temperatures over 200 ^{o}F. The air on the delivery side of the compressor where it enters nylon housing shall not be above the maximum limits as stated in SAE J844. Nylon tubing shall be installed in accordance with the following color-coding standards:

- **Green:** Indicates primary brakes and supply.
- **Red:** Indicates secondary brakes.
- **Brown:** Indicates parking brake
- **Yellow:** Indicates compressor governor signal.
- **Black:** Indicates accessories.

Line supports shall prevent movement, flexing, tension, strain and vibration. Copper lines shall be supported to prevent the lines from touching one another or any component of the bus. To the extent practicable and before installation, the lines shall be pre-bent on a fixture that prevents tube flattening or excessive local strain. Copper lines shall be bent only once at any point, including pre-bending and installation. Rigid lines shall be supported at no more than 5-ft intervals. Nylon lines may be grouped and shall be supported at 30 in. intervals or less.

The compressor discharge line between powerplant and body-mounted equipment shall be flexible convoluted copper or stainless steel line, or may be flexible Teflon hose with a braided stainless steel jacket. Other lines necessary to maintain system reliability shall be flexible Teflon hose with a braided stainless steel jacket. End fittings shall be standard SAE or JIC brass or steel, flanged, swivel-type fittings. Flexible hoses shall be as short as practicable and individually supported. They shall not touch one another or any part of the bus except for the supporting grommets. Flexible lines shall be supported at 2-ft intervals or less.

Air lines shall be clean before installation and shall be installed to minimize air leaks. Compression fittings shall be used for connecting nylon tubing air lines. Push to connect fittings will not be accepted. All air lines shall be routed to prevent water traps to the extent possible. Grommets or insulated clamps shall protect the air lines at all points where they pass through understructure components.

TS 35.4 Air Reservoirs

All air reservoirs shall meet the requirements of FMVSS Standard 121 and SAE Standard J10 and shall be equipped with drain plugs and guarded or flush type drain valves. Major structural members shall protect these valves and any automatic moisture ejector valves from road hazards. Reservoirs shall be sloped toward the drain valve. All air reservoirs shall have drain valves that discharge below floor level with lines routed to eliminate the possibility of water traps and/or freezing in the drain line.

TS 35.5 Air System Dryer

An air dryer shall prevent accumulation of moisture and oil in the air system. The air dryer system shall include one or more replaceable desiccant cartridges. An electrically heated moisture drain valve is not required. The mounting and location shall allow for easy access and removal. A mechanic shall be able to replace the desiccant in less than 15 minutes.

The system shall include a provision to separate and remove suspended oil from compressed air to prevent damage to, or malfunction of pneumatic system components.

The SKF Brakemaster Dual Turbo 2000 air dryer is an approved air dryer for DTPW buses.

A detailed description of the proposed air dryer shall be submitted to DTPW for review and approval prior to production.

ELECTRICAL, ELECTRONIC AND DATA COMMUNICATION SYSTEMS

TS 36. Overview

The electrical system will consist of vehicle battery systems and components that generate, distribute and store power throughout the vehicle. (e.g., generator, voltage regulator, wiring, relays, and connectors).

Electronic devices are individual systems and components that process and store data, integrate electronic information or perform other specific functions.

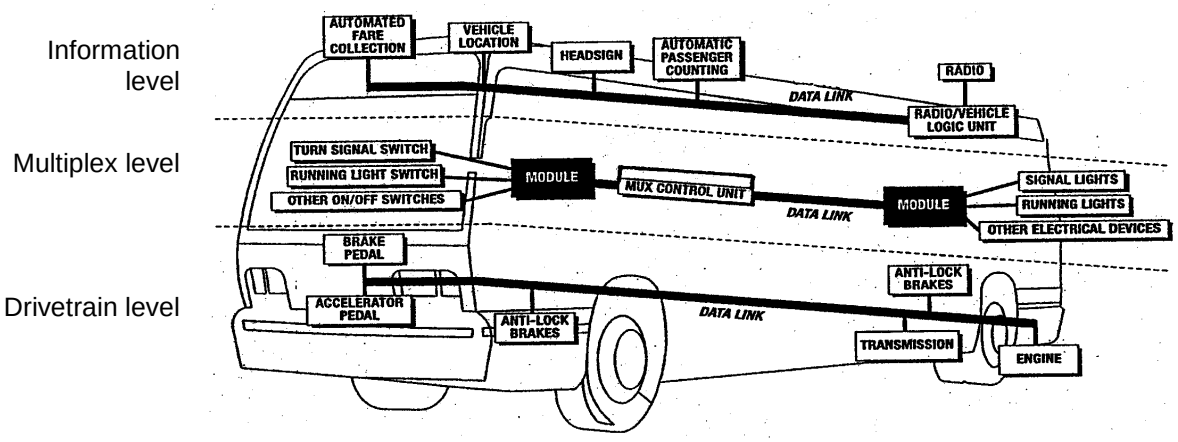
The data communication system consists of the bi-directional communications networks that electronic devices use to share data with other electronic devices and systems. Communication networks are essential to integrating electronic functions, both onboard the vehicle and off.

Information level systems that require vehicle information for their operations or provide information shall adhere to J1939 data standard.

Data communications systems are divided into three levels to reflect the use of multiple data networks:

- **Drivetrain level:** Components related to the drivetrain including the propulsion system components and anti-lock braking system (ABS), which may include traction control.
- **Information level:** Components whose primary function is the collection, control or display of data that is not necessary to the safe drivability of the vehicle (i.e., the vehicle will continue to operate when those functions are inoperable). These components typically consist of those required for automatic vehicle location (AVL) systems, destination signs, fare boxes, passenger counters, radio systems, automated voice and signage systems, video surveillance and similar components.
- **Multiplex level:** Electrical or electronic devices controlled through input/output signals such as discrete, analog and serial data information (i.e., on/off switch inputs, relay or relay control outputs). Multiplexing is used to control components not typically found on the drivetrain or information levels, such as lights; wheelchair lifts; doors; heating, ventilation and air conditioning (HVAC) systems; and gateway devices.

FIGURE 5
Data Communications Systems Levels



TS 36.1 Modular Design

Design of the electrical, electronic and data communication systems shall be modular so that each electronic device, apparatus panel, or wiring bundle is easily separable from its interconnect by means of connectors.

Power plant wiring shall be an independent wiring harness. Replacement of the engine compartment wiring harness(es) shall not require pulling wires through any bulkhead or removing any terminals from the wires.

TS 37. Environmental and Mounting Requirements

The electrical system and its electronic components shall be capable of operating in the area of the vehicle in which they will be installed, as recommended in SAE J1455.

Electrical and electronic equipment shall not be located in an environment that will reduce the performance or shorten the life of the component or electrical system when operating within the design operating profile. As a recommendation, no vehicle component shall generate, or be affected by, electromagnetic interference or radio frequency interference (EMI/RFI) that can disturb the performance of electrical/electronic equipment as defined in SAE J1113 and UNECE Council Directive 95/54 (R 10).

The Agency shall follow recommendations from bus manufacturers and subsystem Suppliers regarding methods to prevent damage from voltage spikes generated from welding, jump starts, shorts, etc.

TS 37.1 Hardware Mounting

The mounting of the hardware shall not be used to provide the sole source ground, and all hardware shall be isolated from potential EMI/RFI, as referenced in SAE J1113.

All electrical/electronic hardware mounted in the interior of the vehicle shall be inaccessible to passengers and hidden from view unless intended to be viewed. The hardware shall be mounted in such a manner as to protect it from splash or spray.

All electrical/electronic hardware mounted on the exterior of the vehicle that is not designed to be installed in an exposed environment shall be mounted in a sealed enclosure.

All electrical/electronic hardware and its mounting shall comply with the shock and vibration requirements of SAE J1455.

All electrical components shall be of Heavy-Duty designs. To the extent practicable, these components shall be designed to last the service life of the bus.

TS 38. General Electrical Requirements

TS 38.1 Batteries

TS 38.1.1 Low-Voltage Batteries (24V) (If Required)

Four Group 31 Series deep cycling maintenance-free battery units shall be provided. Each battery shall have a minimum of 700 cold cranking amps. Each battery shall have a purchase date no more than one year from the date of release for shipment to the Agency. Alternative battery configurations may be considered.

Provide a terminal block in the battery compartment for powering systems, such as but not limited to the DC-DC converter that require constant power when battery cutoff switch is off. Power to the electronic equipment (such as cameras, farebox, radio, CAD/AVL, APC) shall automatically disconnect after approximately one hour after shutting off the ignition.

A permanent vinyl schematic on battery door illustrating configuration shall be provided.

TS 38.1.2 Battery Cables

The battery terminal ends and cables shall be color-coded with red for the primary positive, black for negative and another color for any intermediate voltage cables. Positive and negative battery cables shall not cross each other if at all possible, be flexible and sufficiently long to reach the batteries with the tray in the extended position without stretching or pulling on any connection and shall not lie directly on top of the batteries. Except as interrupted by the master battery switch, battery and starter wiring shall be continuous cables with connections secured by bolted terminals and shall conform to specification requirements of SAE Standard J1127 – Type SGT, SGX or GXL and SAE Recommended Practice J541.

Battery cables shall be marine grade, Type 3 tinned copper conductor (extra flexible stranding), with insulation resistant to oil, heat, moisture, abrasion, UV and ozone. Battery cables shall be 4/0 cable or greater.

TS 38.1.3 Jump Start

A jump start plug, Anderson Power Products 350 amp receptacle (SB-350 6320G1) shall be provided in the rear engine compartment. Submit location of jump start plug to DTPW for approval prior to production.

TS 38.1.4 Battery Compartment

The battery compartment shall prevent accumulation of debris on top of the batteries and shall be well vented, self-draining and located towards the rear of the bus close to the engine. It shall be accessible only from the outside of the vehicle. All components within the battery compartment, and the compartment itself, shall be protected from damage or corrosion from the electrolyte. The inside surface of the battery compartment's access door shall be electrically insulated, as required, to prevent the battery terminals from shorting on the door if the door is damaged in an accident or if a battery comes loose.

The vehicle shall be equipped with a 12VDC and 24VDC quick disconnect switch. The battery compartment door shall conveniently accommodate operation of the 12VDC and 24VDC quick disconnect switch.

The battery quick disconnect access door shall be identified with a decal. The decal size shall not be less than 3.5 × 5 in. (8.89 × 12.7 cm).

The battery hold-down bracket shall be constructed of a non-metallic material (plastic or fiberglass).

This access door shall not require any special locking devices to gain access to the switch, and it shall be accessible without removing or lifting the panel. The door shall be flush-fitting and incorporate a spring tensioner or equal to retain the door in a closed position when not in use.

The batteries shall be securely mounted on a stainless steel tray that can accommodate the size and weight of the batteries. The battery tray shall pull out easily and properly support the batteries while they are being serviced. The tray shall allow each battery cell to be easily serviced. A locking device shall retain the battery tray to the stowed position.

If not located in the engine compartment, the same fire-resistant properties must apply to the battery compartment. No sparking devices should be located within the battery box.

The inside surface of the battery compartment's access door shall be electrically insulated, as required, to prevent the battery terminals shorting on the door if the door is damaged in an accident or if a battery comes loose.

TS 38.1.5 Auxiliary Electronic Power Supply

If required, gel-pack, or any form of sealed (non-venting) batteries used for auxiliary power are allowed to be mounted on the interior of the vehicle if they are contained in an enclosed, non-airtight compartment and accessible only to maintenance personnel. This compartment shall contain a warning label prohibiting the use of lead-acid batteries.

TS 38.1.6 Master Battery Switch

A single master switch shall be provided near the battery compartment for the disconnecting of all battery positives (12V and 24V), except for safety devices such as the fire suppression system and other systems as specified. The location of the master battery switch shall be clearly identified on the exterior access panel, be accessible in less than 10 seconds for deactivation and prevent corrosion from fumes and battery acid when the batteries are washed off or are in normal service.

Turning the master switch off with the power plant operating shall not damage any component of the electrical system. The master switch shall be capable of carrying and interrupting the total circuit load.

TS 38.1.7 Low-Voltage Generation and Distribution

The low-voltage generating system shall maintain the charge on fully charged batteries, except when the vehicle is at standard idle with a total low voltage generator load exceeding 70 percent of the low voltage generator nameplate rating.

Voltage monitoring and over-voltage output protection (recommended at 32V) shall be provided.

Dedicated power and ground shall be provided as specified by the component or system manufacturer. Cabling to the equipment must be sized to supply the current requirements with no greater than a 5 percent volt drop across the length of the cable.

DTPW requires that a constant power shall be provided to the farebox, APC, radio system, CCTV, and fire suppression on the buses with the master run switch in any position and/or when the master battery cutoff switch is off. Description of the constant power provision to the farebox, APC, radio system, CCTV, and fire suppression shall be provided to DTPW prior to production for approval.

<u>Automatic Low Voltage Battery Disconnect</u>

An automatic low voltage battery disconnect shall interrupt selected loads on the constant power side of the master battery switch in order to prevent excessive battery discharge from radio, farebox, APC, and CCTV loads when the bus master run switch is off. All equipment location, accessibility, and mounting shall be provided to DTPW prior to production for approval.

TS 38.1.8 Circuit Protection

All branch circuits shall be protected by current-limiting devices such as circuit breakers, fuses or solid state devices sized to the requirements of the circuit. The circuit breakers or fuses shall be easily accessible for authorized personnel. Fuses shall be used only where it can be demonstrated that circuit breakers are not practicable. This requirement applies to in-line fuses supplied by either the Contractor or a Supplier. Fuse holders shall be constructed to be rugged and waterproof. All manual reset circuit breakers critical to the operation of the bus shall be mounted in a location convenient to the Agency mechanic with visible indication of open circuits. The Contractor shall show all in-line fuses in the final harness drawings. Any manually resettable circuit breakers shall provide a visible indication of open circuits. Any manually resettable circuit breakers shall provide a visible indication of open circuits.

The windshield wiper and headlamps electric circuit shall be protected by modified auto-reset circuit breakers sized to the requirement of the load.

Rubber Covers shall be provided for all the Electric Post.

Electrical compartments shall be sealed to prevent intrusion of moisture. The components and circuits in electrical compartments shall be identified and their location permanently recorded on a drawing attached to the inside of the access panel or door. The drawing shall be protected from oil, grease, fuel, and abrasion. The front compartment shall be completely serviceable from the operator's seat, vestibule, or from outside. Electrical panels accessed from the exterior of the bus shall be of stainless steel construction.

All junction boxes located in the engine compartment shall be designed to allow thorough steam cleaning of the engine compartment area without intrusion of water.

Circuit breakers or fuses shall be sized to a minimum of 15 percent larger than the total circuit load. The current rating for the wire used for each circuit must exceed the size of the circuit protection being used.

<u>High Voltage Devices</u>

All devices that contain circuits or equipment energized or capable of being energized at high voltage shall be contained within protective enclosures or enclosed bus body compartments. All access covers for these compartments shall be permanently labeled with ‘DANGER HIGH VOLTAGE’ signs.

All conductors carrying voltages of 50 VAC or greater, shall be considered High Voltage (HV). All HV wiring must be installed separately from low voltage wiring and must be installed damage free. Conductors, insulation, cable supports and terminating connections must be designed for the purpose, voltage and operating conditions.

TS 38.2 Grounds

The battery shall be grounded to the vehicle chassis/frame at one location only, as close to the batteries as possible. When using a chassis ground system, the chassis shall be grounded to the frame in multiple locations, evenly distributed throughout the vehicle to eliminate ground loops. No more than four ground ring/spade terminal connections shall be made per ground stud. Electronic equipment requiring an isolated ground to the battery (i.e., electronic ground) shall not be grounded through the chassis.

TS 38.3 Low Voltage/Low Current Wiring and Terminals

All main power supply and ground cables size 6 AWG and larger shall be marine grade, Type 3 tinned copper conductor (extra flexible stranding), with insulation resistant to oil, heat, moisture, abrasion, UV and ozone.

Ground cable shall be the same size of the power supply cable in every circuit.

All Branch circuits shall be protected by circuit breakers or fuses at the source end of the circuit, sized to the requirements of the load.

All power and ground wiring shall conform to specification requirements of SAE Recommended Practice J1127, J1128 and J1292. Double insulation shall be maintained as close to the junction box, electrical compartment or terminals as possible. The requirement for double insulation shall be met by wrapping the harness with plastic electrical tape or by sheathing all wires and harnesses with non-conductive, rigid or flexible conduit.

Wiring shall be hot stamped numbered as well as color coded. Wiring harnesses shall not contain wires of different voltage classes unless all wires within the harness are insulated for the highest voltage present in the harness. Kinking, grounding at multiple points, stretching, and exceeding minimum bend radius shall be prevented.

Strain-relief fittings shall be provided at all points where wiring enters electrical compartments. Grommets or other protective material shall be installed at points where wiring penetrates metal structures outside of electrical enclosures. Wiring supports shall be protective and non-conductive at areas of wire contact and shall not be damaged by heat, water, solvents or chafing.

To the extent practicable, wiring shall not be located in environmentally exposed locations under the vehicle. Wiring and electrical equipment necessarily located under the vehicle shall be insulated from water, heat, corrosion and mechanical damage. Where feasible, front to rear electrical harnesses should be installed above the window line of the vehicle.

The instrument panel and wiring shall be easily accessible for service from the driver's seat or top of the panel. The instrument panel shall be separately removable and replaceable without damaging the instrument panel or gauges. Wiring shall have sufficient length and be routed to permit service without stretching or chafing the wires.

Schematics illustrating wiring configuration shall be provided on all electrical compartment doors.

All main power supply terminals shall be covered with electric post rubber cover.

All electrical end plugs shall be covered.

The wiring harnesses shall incorporate 10% spare wires.

Wiring located in the engine compartment shall be routed away from high-heat sources or shielded and/or insulated from temperatures exceeding the wiring and connector operating requirements.

All cables and harnesses shall be secured to prevent chafing or shorting against each other or any part of the vehicle. Clamps shall be rubber or PVC clad aircraft type.

Grommets or other protective material shall be installed at points where wiring penetrates metal structures.

All wiring shall start and end at a junction block or component.

All terminal ends shall end on stud/nut or screw type junction blocks. Only tin/lead covered, non-insulated, brazed seam, copper terminals will be used underneath the bus, in the engine compartment, and heater compartment. All terminals and adjoining wire shall be covered with heat shrink tubing that has an inner meltable liner. The heat shrink will also act as a stain relief. The heat shrink shall be applied with a heat gun. A flame is not acceptable.

Multiple pin type connectors shall be provided to permit rapid disconnect of multiple circuits for engine, transmission, and closure door wiring. Directional signal switch shall have inline connectors.

All inline and bulkhead connectors are to be of the weather pack sealed type.

Multi-pin connectors shall be protected internally from corrosion with silicone dielectric grease (Dow Corning #4).

All circuits except the engine emergency shut-off and speedometer circuits must be protected by reset circuit breakers that clearly indicate their position when tripped. Each breaker must be labeled. Circuit breakers must have plastic dust caps.

TS 38.4 Electrical Components

All electrical components, including switches, relays, flashers and circuit breakers, shall be heavy-duty designs with either a successful history of application in heavy-duty vehicles or design specifications for an equivalent environment.

All electric motors shall be heavy-duty brushless type where practical, and have a continuous duty rating of no less than 40,000 hours (except cranking motors, washer pumps and wiper motors). All electric motors shall be easily accessible for servicing.

TS 38.5 Electrical Compartments

Electrical compartments shall be sealed to prevent intrusion of moisture. The components and circuits in electrical compartments shall be identified and their location permanently recorded on a drawing attached to the inside of the access panel or door. The drawing shall be protected from oil, grease, fuel, and abrasion. The front compartment shall be completely serviceable from the operator's seat, vestibule, or from outside. Electrical panels accessed from the exterior of the bus shall be of stainless steel construction.

All junction boxes located in the engine compartment shall be stainless steel and designed to allow thorough steam cleaning of the engine compartment area without intrusion of water. “Rear start and run” controls shall be mounted in an accessible location in the engine compartment and shall be protected from the environment.

TS 39. General Electronic Requirements

If an electronic component has an internal real-time clock, it shall provide its own battery backup to monitor time when battery power is disconnected, and/or it may be updated by a network component. If an electronic component has an hour meter, it shall record accumulated service time without relying on battery backup.

All electronic component Suppliers shall ensure that their equipment is self-protecting in the event of shorts in the cabling, and also in over-voltage (over 32V DC on a 24V DC nominal voltage rating with a maximum of 50V DC) and reverse polarity conditions. If an electronic component is required to interface with other components, it shall not require external pull-up and/or pull-down resistors. Where this is not possible, the use of a pull-up or pull-down resistor shall be limited as much as possible and easily accessible and labeled.

Provide a 24 volt to 13.6 volt DC-DC converter, 30 ampere output, Model 1645-24-12-30, manufactured by Wilmore Electronics Co., Inc., P.O. Box 1329, Hillsborough, N.C. 27278. Telephone: (919) 732-9351. The unit shall be located in the communications equipment box and will provide power to a terminal block for the

Radio, VLU, DR700 stop announcement system, CCTV system, Farebox, and Destination sign. The converter will receive power from the batteries before the master battery cutoff switch. Continuous power to the DC-DC converter must be supplied with the master run switch in "off" position.

Provide a 12 volt power supply port in the vicinity diagnostic connector ports in the operator's area and in the engine compartment.

TS 39.1 Wiring and Terminals

Kinking, grounding at multiple points, stretching and reducing the bend radius below the manufacturer's recommended minimum shall not be permitted.

TS 39.1.1 Discrete I/O (Inputs/Outputs)

All wiring to I/O devices, either at the harness level or individual wires, shall be labeled, stamped or color-coded in a fashion that allows unique identification at a spacing not exceeding 4 in. Wiring for each I/O device shall be bundled together. If the I/O terminals are the same voltages, then jumpers may be used to connect the common nodes of each I/O terminal.

TS 39.1.2 Shielding

All wiring that requires shielding shall meet the following minimum requirements. A shield shall be generated by connecting to a ground, which is sourced from a power distribution bus bar or chassis. A shield shall be connected at one location only, typically at one end of the cable. However certain standards or special requirements, such as SAE J1939 or RF applications, have separate shielding techniques that also shall be used as applicable.

NOTE: A shield grounded at both end forms a ground loop, which can cause intermittent control or faults.

When using shielded or coaxial cable, upon stripping of the insulation, the metallic braid shall be free from frayed strands, which can penetrate the insulation of the inner wires. To prevent the introduction of noise, the shield shall not be connected to the common side of a logic circuit.

TS 39.1.3 Communications

The data network cabling shall be selected and installed according to the selected protocol requirements. The physical layer of all network communication systems shall not be used for any purpose other than communication between the system components, unless provided for in the network specifications.

Communications networks that use power line carriers (e.g., data modulated on a 24V-power line) shall meet the most stringent applicable wiring and terminal specifications.

TS 39.1.4 Radio Frequency (RF)

RF components, such as radios, video devices, cameras, global positioning systems (GPS), etc., shall use coaxial cable to carry the signal. All RF systems require special design consideration for losses along the cable. Connectors shall be minimized, since each connector and crimp has a loss that will attribute to attenuation of the signal. Cabling should allow for the removal of antennas or attached electronics without removing the installed cable between them. If this cannot be done, then a conduit of sufficient size shall be provided for ease of attachment of antenna and cable assembly. The corresponding component vendors shall be consulted for proper application of equipment, including installation of cables.

TS 39.1.5 Audio

Cabling used for microphone level and line level signals shall be 22 AWG minimum with shielded twisted pair. Cabling used for amplifier level signals shall be 18 AWG minimum.

TS 40. Multiplexing

TS 40.1 General

The primary purpose of the multiplexing system is control of components necessary to operate the vehicle. This is accomplished by processing information from input devices and controlling output devices through the use of an internal logic program.

Versatility and future expansion shall be provided for by expandable system architecture. The multiplex system shall be capable of accepting new inputs and outputs through the addition of new modules and/or the utilization of existing spare inputs and outputs. Ten percent of the total number of inputs and outputs, or at least one each for each voltage type utilized (0V, 12V, 24V), at each module location shall be designated as spares. All like components in the multiplex system shall be modular and interchangeable with self-diagnostic capabilities. The modules shall be easily accessible for troubleshooting electrical failures and performing system maintenance. Multiplex input/output modules shall use solid-state devices to provide extended service life and individual circuit protection.

TS 40.2 System Configuration

Multiplexing may either be distributed or centralized. A distributed system shall process information on multiple control modules within the network. A centralized system shall process the information on a single control module. Either system shall consist of several modules connected to form a control network.

TS 40.2.1 I/O Signals

The input/output for the multiplex system may contain three types of electrical signals: discrete, analog or serial data.

Discrete signals shall reflect the on/off status of switches, levers, limit switches, lights, etc. Analog signals shall reflect numerical data as represented by a voltage signal (0-12V, 10-24V, etc.) or current signal (4-20 mA). Both types of analog signals shall represent the status of variable devices such as rheostats, potentiometers, temperature probes, etc. Serial data signals shall reflect ASCII or alphanumeric data used in the communication between other on-board components.

TS 41. Data Communications

TS 41.1 General

All data communication networks shall be either in accordance with a nationally recognized interface standard, such as those published by SAE, IEEE or ISO, or shall be published to DTPW with the following minimum information:

- Protocol requirements for all timing issues (bit, byte, packet, inter-packet timing, idle line timing, etc.) packet sizes, error checking and transport (bulk transfer of data to/from the device).
- Data definition requirements that ensure access to diagnostic information and performance characteristics.
- The capability and procedures for uploading new application or configuration data.
- Access to revision levels of data, application software and firmware.
- The capability and procedures for uploading new firmware or application software.
- Evidence that applicable data shall be broadcast to the network in an efficient manner such that the overall network integrity is not compromised.

Any electronic vehicle components used on a network shall be conformance tested to the corresponding network standard.

TS 41.2 Drivetrain Level

Drivetrain components, consisting of the engine, transmission, retarder, anti-lock braking system and all other related components, shall be integrated and communicate fully with respect to vehicle operation with data using SAE Recommended Communications Protocols such as J1939 and/or J1708/J1587 with forward and backward compatibilities or other open protocols.

TS 41.2.1 Diagnostics, Fault Detection and Data Access

Drivetrain performance, maintenance and diagnostic data, and other electronic messages shall be formatted and transmitted on the communications networks.

The drivetrain level shall have the ability to record abnormal events in memory and provide diagnostic codes and other information to service personnel. At a minimum, this network level shall provide live/fail status, current hardware serial number, software/data revisions and uninterrupted timing functions.

TS 41.2.2 Programmability (Software)

The drivetrain level components shall be programmable by DTPW with limitations as specified by the sub-system Supplier.

TS 41.3 Multiplex Level

TS 41.3.1 Data Access

At a minimum, information shall be made available via a communication port on the multiplex system. The location of the communication port shall be easily accessible. A hardware gateway and/or wireless communications system are options if requested by DTPW. The communication port(s) shall be located as specified by DTPW.

TS 41.3.2 Diagnostics and Fault Detection

The multiplex system shall have a proven method of determining its status (system health and input/output status) and detecting either active (online) or inactive (offline) faults through the use of on-board visual/audible indicators.

In addition to the indicators, the system shall employ an advanced diagnostic and fault detection system, which shall be accessible via either a personal computer or a handheld unit. Either unit shall have the ability to check logic function. The diagnostic data can be incorporated into the information level network or the central data access system.

Multiplexing System Mock-up Board

An optional mock-up board, where key components of the multiplexing system are replicated on a functional model, shall be provided as a tool for diagnostic, design verification and training purposes. If required, the mock-up board should be priced separately.

TS 41.3.3 Programmability (Software)

The multiplex system shall have security provisions to protect its software from unwanted changes. This shall be achieved through any or all of the following procedures:

- password protection
- limited distribution of the configuration software
- limited access to the programming tools required to change the software
- hardware protection that prevents undesired changes to the software

Provisions for programming the multiplex system shall be possible through a PC or laptop. The multiplex system shall have proper revision control to ensure that the hardware and software are identical on each vehicle equipped with the system. Revision control shall be provided by all of the following:

- hardware component identification where labels are included on all multiplex hardware to identify components
- hardware series identification where all multiplex hardware displays the current hardware serial number and firmware revision employed by the module
- software revision identification where all copies of the software in service displays the most recent revision number
- a method of determining which version of the software is currently in use in the multiplex system

TS 41.4 Electronic Noise Control

Electrical and electronic sub-systems and components on all buses shall not emit electromagnetic radiation that will interfere with on-board systems, components or equipment, telephone service, radio or TV reception or violate regulations of the Federal Communications Commission.

Electrical and electronic sub-systems on the coaches shall not be affected by external sources of RFI/EMI. This includes, but is not limited to, radio and TV transmission, portable electronic devices including computers in the vicinity of or onboard the buses, ac or dc power lines and RFI/EMI emissions from other vehicles.

DRIVER PROVISIONS, CONTROLS AND INSTRUMENTATION

TS 42. Driver's Area Controls

TS 42.1 General

In general when designing the driver's area, it is recommended that SAE J833, "Human Physical Dimensions," be used.

Switches and controls shall be divided into basic groups and assigned to specific areas, in conformance with SAE Recommended Practice J680, Revised 1988, "Location and Operation of Instruments and Controls in Motor Truck Cabs," and be essentially within the hand reach envelope described in SAE Recommended Practice J287, "Driver Hand Control Reach."

An operator's area enclosure shall be provided as described in the Driver Area Barrier section of the specifications.

The Contractor shall furnish and install one (1) general model #TCP5JH, or approved equal, ABC rated, 5 pounds, dry chemical type extinguisher with special non-kink, 12 inch hose assembly. The fire extinguisher shall be located on the roadside of the bus behind the driver's seat if practical. Mounting to be approved by DTPW at the time of bus manufacture. Mounting of the extinguisher shall be rigid and shall prevent vibration and noise. The mounting shall be a Spring-Grip bracket manufactured by Brooks Equipment or approved equal. On the outside of the fire extinguisher there shall be a metal label indicating that the fire extinguisher has been listed and approved by the Underwriter's Laboratories and Factory Mutual Laboratories. A sticker with the date the extinguisher was last inspected shall be placed visibly on the unit.

Provide Three (3) highway warning triangles in a reusable plastic container and an accompanying mounting bracket shall be provided. The Portable Red Reflector warning device (Triangle reflector) shall be in compliance with section 316.300, Florida Statutes. Locate triangles behind the driver seat, if practical. Provide accompanying mounting bracket K.D. part #616-9000.

TS 42.2 Glare

The driver's work area shall be designed to minimize glare to the extent possible. Objects within and adjacent to this area shall be matte black or dark gray in color wherever possible to reduce the reflection of light onto

the windshield. The use of polished metal and light-colored surfaces within and adjacent to the driver's area shall be avoided.

TS 42.3 Visors/Sun Shades

An adjustable roller type sunscreen shall be provided over the driver's windshield and/or the driver's side window. The sunscreen shall be capable of being lowered to the midpoint of the driver's window. When deployed, the screen shall be secure, stable and shall not rattle, sway or intrude into the driver's field of view due to the motion of the coach or as a result of air movement. Once lowered, the screen shall remain in the lowered position until returned to the stowed position by the driver. Sunscreen shall be shaped to minimize light leakage between the visor and windshield pillars to the extent possible

TS 42.4 Driver's Controls

Frequently used controls must be in easily accessible locations. These include the door control, kneel control, windshield wiper/washer controls, ramp, and lift and run switch. Any switches and controls necessary for the safe operation of the bus shall be conveniently located and shall provide for ease of operation. They shall be identifiable by shape, touch and permanent markings. Controls also shall be located so that passengers may not easily tamper with control settings.

All panel-mounted switches and controls shall be marked with easily read identifiers. Graphic symbols shall conform to SAE Recommended Practice J2402, "Road Vehicles – Symbols For Controls, Indicators, and Tell Tales," where available and applicable. Color of switches and controls shall be dark with contrasting typography or symbols.

Mechanical switches and controls shall be replaceable, and the wiring at these controls shall be serviceable from a convenient location. Switches, controls and instruments shall be dust- and water-resistant.

TS 42.5 Normal Bus Operation Instrumentation and Controls

The following list identifies bus controls used to operate the bus. These controls are either frequently used or critical to the operation of the bus. They shall be located within easy reach of the operator. The operator shall not be required to stand or turn to view or actuate these controls unless specified otherwise.

Systems or components monitored by onboard diagnostics system shall be displayed in clear view of the operator and provide visual and/or audible indicators. The intensity of indicators shall permit easy determination of on/off status in bright sunlight but shall not cause a distraction or visibility problem at night. All indicators shall be illuminated using backlighting.

The indicator panel shall be located in Area 1 or Area 5, within easy view of the operator instrument panel. All indicators shall have a method of momentarily testing their operation. The audible alarm shall be tamper-resistant and shall have an outlet level between 80 and 83 dBA when measured at the location of the operator's ear.

On-board displays visible to the operator shall be limited to indicating the status of those functions described herein that are necessary for the operation of the bus. All other indicators needed for diagnostics and their related interface hardware shall be concealed and protected from unauthorized access. Table below represents instruments and alarms. The intent of the overall physical layout of the indicators shall be in a logical grouping of systems and severity nature of the fault.

Consideration shall be provided for future additions of spare indicators as the capability of onboard diagnostic systems improves. Blank spaces shall contain LEDs.

A detailed visual indicator layout with alternatives and audible alarm provision of bus instruments and alarms shall be provided to DTPW for review and approval during the preproduction meeting.

Transit Bus Instruments and Alarms

Device	Description	Location	Function	Visual/ Audible
Master run switch	Rotary, four-position detent	Side console	Master control for bus, off, day run, night run and clearance ID lights	
Drive selector	Touch panel switch	Side console	Provides selection of propulsion: forward, reverse and neutral	Gear selection
HVAC	Switch or switches to control HVAC	Side console	Permits selection of passenger ventilation: off, cool, heat, low fan, high fan or full auto with on/off only	
Driver's ventilation	Rotary, three-position detent	Side console or Dash left wing	Permits supplemental ventilation: fan off, low or high	
Defroster fan	Rotary, three-position detent	Side console or Dash left wing	Permits defroster: fan off, low, medium or high	
Defroster temperatur e	Variable position	Side console or Dash left wing	Adjusts defroster water flow and temperature	
Windshield wiper	One-variable rotary position operating both wipers	Dash left wing	Variable speed control of left and right windshield wipers	
Windshield washer	Push button	Dash left wing	Activates windshield washers	
Dash panel lights	Rotary rheostat or stepping switch	Side Console or Dash left wing	Provides adjustment for light intensity in night run position	
Interior lights	Three-position switch	Side console	Selects mode of passenger compartment lighting: off, on, normal	
Front door ramp	Three-position momentary switch	Right side of steering wheel	Permits deploy and stow of front ramp	Amber dash indicator. Ext alarm and Amber light
Front kneel	Three-position momentary switch	Front door remote	Permits kneeling activation and raise and normal at front door remote location	Amber dash indicator. Ext alarm and Amber light
Silent alarm	Recessed push button, NO and NC contacts momentary	Side console	Activates emergency radio alarm at dispatch and permits covert microphone and/or enables destination sign emergency message	

Transit Bus Instruments and Alarms

Device	Description	Location	Function	Visual/ Audible
Video system event switch	Momentary on/off momentary switch with plastic guard	Side console	Triggers event equipment, triggers event light on dash	Amber light
Left remote mirror	Four-position toggle type	Side console	Permits two-axis adjustment of left exterior mirror	
Right remote mirror	Four-position toggle type	Side console	Permits two-axis adjustment of right exterior mirror	
Mirror heater	Switch or temperature activated	Side console	Permits heating of outside mirrors when required	
Passenger door control	Five-position handle type detent or two momentary push buttons	Side console, forward	Permits open/close control of front and rear passenger doors	Red light
Rear door override	Two-position switch in approved location	Side console, forward	Allows driver to override activation of rear door passenger tape switches	
Shutdown override	Momentary switch with operation protection	Side console	Permits driver to override auto shutdown	
Hazard flashers	Two-position switch	Side console or Dash right wing	Activates emergency flashers	Two green lights
Fire suppressio n	Red push button with protective cover	Dash left wing or dash center	Permits driver to override and manually discharge fire suppression system	Red light
Mobile data terminal	Mobile data terminal coach operator interface panel	Above right dash wing	Facilitates driver interaction with communication system and master log-on	LCD display with visual status and text messages
Farebox interface	Farebox coach operator interface panel	Near farebox	Facilitates driver interaction with farebox system	LCD display
Destination sign interface	Destination sign interface panel	in approved location	Facilitates driver interaction with destination sign system, manual entry	LCD display
Turn signals	Momentary push button (two required) raised from other switches	Left foot panel	Activates left and right turn signals	Two green lights and optional audible indicator
PA manual	Momentary push button	In approved location	Permits driver to manually activate public address microphone	

Transit Bus Instruments and Alarms

Device	Description	Location	Function	Visual/ Audible
Low profile microphone	Low-profile discrete Mounting	Steering column	Permits driver to make announcements with both hands on the wheel and focusing on road conditions	
High beam	Detented push button	In approved location	Permits driver to toggle between low and high beam	Blue light
Parking brake	Pneumatic PPV	Side console or Dash left wing	Permits driver to apply and release parking brake	Red light
Park brake release	Pneumatic PPV	Vertical side of the side console or dash center	Permits driver to push and hold to release brakes	
Master door/ interlock	Multi-pole toggle, detented	Out of operator's reach	Permits driver override to disable door and brake/throttle interlock	Red light
Warning interlocks deactivated	Red indicator light	Dash panel center	Illuminates to warn drive that interlocks have been deactivated.	Red light
Retarder disable	Multi-pole switch detented	Within reach of Operator or approved location	Permits driver override to disable brake retardation/regeneration	Red light
Alarm acknowledge	Push button momentary	Approved location	Permits driver to acknowledge alarm condition	
Rear door passenger sensor disable	Multi-pole toggle, detented	In sign compartment or Driver's barrier compartment	Permits driver to override rear door passenger sensing system	
Indicator/ alarm test button	Momentary switch or programming[1]	Dash center panel	Permits driver to activate test of sentry, indicators and audible alarms	All visuals and audibles
Auxiliary power	110-volt power receptacle	Approved location	Property to specify what function to supply	
Speedometer	Speedometer, odometer, and diagnostic capability, 5-mile increments	Dash center panel	Visual indication of speed and distance traveled, accumulated vehicle mileage, fault condition display	Visual
Air pressure gauge	Primary and secondary, 5 psi increments	Dash center panel	Visual indication of primary and secondary air systems	Red light and buzzer
Fire detection	Coach operator display	Property specific or dash center	Indication of fire detection activation by zone/location	Buzzer and red light

Transit Bus Instruments and Alarms

Device	Description	Location	Function	Visual/ Audible
Door obstruction	Sensing of door obstruction	Dash center	Indication of rear door sensitive edge activation	Red light and buzzer
Door ajar	Door not properly closed	Property specific or dash center	Indication of rear door not properly closed	Buzzer or alarm and red light
Low system air pressure	Sensing low primary and secondary air tank pressure	Dash center	Indication of low air system pressure	Buzzer and red light
Low coolant indicator	Low coolant indicator may be supplied as audible alert and visual and/or text message	Within driver's sight	Detects low coolant condition	Amber light
ABS indicator	Detects system status	Dash center	Displays system failure	Amber light
HVAC indicator	Detects system status	Dash center	Displays system failure	Amber or red light
Charging system indicator (12/24 V)	Detect charging system status	Dash center	Detects no charge condition and optionally detects battery high, low, imbalance, no charge condition, and initiates time-delayed shutdown	Red light flashing or solid based on condition
Bike rack deployed indicator	Detects bike rack position	Dash center	Indication of bike rack not being in fully stowed position	Amber or red light

1. Indicate area by drawing. Break up switches control from indicator lights.

TS 42.6 Driver Foot Controls

Accelerator and brake pedals shall be designed for ankle motion. Foot surfaces of the pedals shall be faced with wear-resistant, nonskid, replaceable material.

TS 42.6.1 Pedal Angle

The vertical angle of the accelerator and brake pedals shall be determined from a horizontal plane regardless of the slope of the cab floor. The accelerator and brake pedals shall be positioned at an angle of 37 to 50 degrees at the point of initiation of contact and extend downward to an angle of 10 to 18 degrees at full throttle.

The location of the brake and accelerator pedals shall be determined by the manufacturer, based on space needs, visibility, lower edge of windshield, and vertical H-point.

TS 42.6.2 Pedal Dimensions and Position

The floor-mounted accelerator pedal shall be 10 to 12 in. long and 3 to 4 in. wide. Clearance around the pedal must allow for no interference precluding operation.

TS 42.7 Brake and Accelerator Pedals

Non-adjustable brake pedal.

Brake and accelerator pedals shall be mounted on removable mounting plates to allow easy access for maintenance.

TS 42.8 Driver Foot Switches

Floor-Mounted Foot Control Platform

The control switches for the turn signals, hazard warning flashers, high beam and public address (PA) system shall be mounted on an inclined, floor-mounted stainless steel enclosure or metal plate mounted to an incline integrated into the driver's platform, located to the left of the steering column. The location and design of this enclosure shall be such that foot room for the operator is not impeded. The inclined mounting surface shall be skid-resistant. All controls, including high beam and PA system shall be in approved location. The angle of the turn signal platform shall be determined from a horizontal plane, regardless of the slope of the cab floor. The turn signal platform shall be angled at a minimum of 10 degrees and a maximum of 37 degrees. It shall be located no closer to the seat front than the heel point of the accelerator pedal.

The foot switches shall be UL-listed, heavy-duty type, of a rugged, water-resistant, corrosion-resistant metal construction. The foot switches for the directional signals and hazard warning shall be momentary type, while those for the PA system and the high beam shall be latching type. The spacing of the switches shall be such that inadvertent simultaneous deflection of switches is prevented.

A detailed control layout shall be provided to DTPW for review and approval during the preproduction meeting.

TS 43. Driver's Amenities

TS 43.1 Coat Hanger

A driver's metal coat hook shall be mounted in a location convenient to the driver (location to be determined by DTPW at time of manufacture).

TS 43.2 Drink Holder

No drink holder.

TS 43.3 Storage Box

An enclosed driver storage area shall be provided with a positive latching door and/or lock. The minimum size is 2750 cubic in.

TS 44. Windshield Wipers and Washers

TS 44.1 Windshield Wipers

The bus shall be equipped with a windshield wiper for each half of the windshield. At 60 mph, no more than 10 percent of the wiped area shall be lost due to windshield wiper lift. For two- piece windshields, both wipers shall park along the center edges of the windshield glass. For single-piece windshields, wipers shall park along the bottom edge of the windshield. Windshield wiper motors and mechanisms shall be easily accessible for repairs or service. The fastener that secures the wiper arm to the drive mechanism shall be corrosion-resistant.

The windshield wipers control shall be single-control, electric two-speed intermittent wiper.

TS 44.2 Windshield Washers

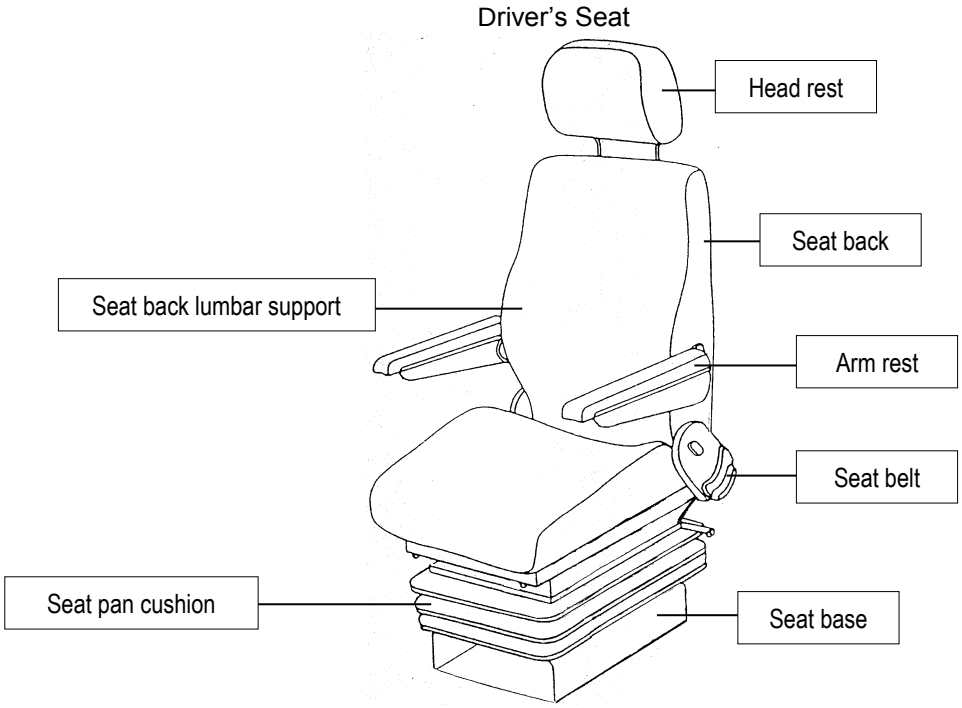
The electric windshield washer system, when used with the wipers, shall deposit washing fluid evenly and completely wet the entire wiped area.

The windshield washer system shall have a minimum 3-gallon reservoir, located for easy refilling from outside of the bus. Reservoir pumps, lines and fittings shall be corrosion-resistant and must include a means to determine fluid level.

TS 45. Driver's Seat

Operator's seat shall be a USSC 9100 ALX3 pneumatic suspension seat or approved equal. This is a high back model and shall have no armrest. Installation of the seat shall not interfere with any of the adjustment features of the seat. The driver's seat shall be upholstered with black vinyl. The seat frame shall be of satin finish stainless steel, box type, tubular construction, reinforced where necessary to prevent failure due to vibration and shall be readily removable from the base.

With the seat fully lowered and in fully forward position, the horizontal distance measured between the edge of the seat cushion and the fixed steering column housing shall be a minimum of six (6) inches.



TS 45.1 Dimensions

The driver's seat shall be comfortable and adjustable so that people ranging in size from a 95th-percentile male to a 5th-percentile female may operate the bus.

TS 45.1.1 Seat Pan Cushion Length

Measurement shall be from the front edge of the seat pan to the rear at its intersection with the seat back. The adjustment of the seat pan length shall be no less than 16.5 in. at its minimum length and no more than 20.5 in. at its maximum length.

SP 1.1.1 Seat Pan Cushion Height

Measurement shall be from the cab floor to the top of the level seat at its center midpoint. The seat shall adjust in height from a minimum of 14 in., with a minimum 6 in. vertical range of adjustment.

TS 45.1.2 Seat Pan Cushion Slope

Measurement is the slope of the plane created by connecting the two high points of the seat, one at the rear of the seat at its intersection with the seat back and the other at the front of the seat just before it waterfalls downward at the edge. The slope can be measured using an inclinometer and shall be stated in degrees of incline relative to the horizontal plane (0 degrees). The seat pan shall adjust in its slope from no less than plus 12 degrees (rearward “bucket seat” incline), to no less than minus 5 degrees (forward slope).

TS 45.1.3 Seat Base Fore/Aft Adjustment

Measurement is the horizontal distance from the heel point to the front edge of the seat. The minimum and maximum distances shall be measured from the front edge of the seat when it is adjusted to its minimum seat pan depth (approximately 15 in.). The total travel measured for the operator's seat, from fully retracted to fully extended position in its guideway, shall be a minimum of 11 inches. It shall adjust no closer to the heel point than 6 in.

TS 45.1.4 Seat Pan Cushion Width

Measurement is the horizontal distance across the seat cushion. The seat pan cushion shall be 17 to 21 in. across at the front edge of the seat cushion and 20 to 23 in. across at the side bolsters.

TS 45.1.5 Seat Suspension

The driver’s seat shall be appropriately dampened to support a minimum weight of 500 lbs. The suspension shall be capable of dampening adjustment in both directions.

Rubber snubbers shall be provided to prevent metal-to-metal contact.

TS 45.1.6 Seat Back

Width

Measurement is the distance between the outermost points of the front of the seat back, at or near its midpoint in height. The seat back width shall be no less than 19 in. Seat back will include dual recliner gears on both sides of the seat.

Height

Standard height seat back.

TS 45.1.7 Headrests

Adjustable headrest.

TS 45.1.8 Seat Back Lumbar Support

Measurement is from the bottom of the seat back at its intersection with the seat pan to the top of the lumbar cushioning. The seat back shall provide adjustable depth lumbar back support with three individual operating lumbar cells within a minimum range of 7 to 11 in.

TS 45.1.9 Seat Back Angle Adjustment

The seat back angle shall be measured relative to a level seat pan, where 90 degrees is the upright position and 90 degrees-plus represents the amount of recline.

The seat back shall adjust in angle from a minimum of no more than 90 degrees (upright) to at least 105 degrees (reclined), with infinite adjustment in between.

TS 45.2 Seat Belt

Seat belts shall be provided across the driver's lap and diagonally across the driver's chest. The driver shall be able to use both belts by connecting a single buckle on the right side of the seat cushion. 3-pt seatbelts must be emergency locking retractor (ELR) in design.

The driver's seat must come equipped with the longest retractable safety belt offered by the manufacturer. The driver's seat shall have a seat belt, meeting requirements of Federal Motor Vehicle Safety Standard No. 207 and No.210. The seat belt shall have an automatic ratcheting retractor on the left-hand side, and the mating part on the right-hand side shall be as short as possible. Seat belt shall be black.

An 8-in. (minimum) extension shall be provided for the lap belt assembly with each bus.

TS 45.3 Adjustable Armrest

No armrests.

TS 45.4 Seat Control Locations

While seated, the driver shall be able to make seat adjustments by hand without complexity, excessive effort or being pinched. Adjustment mechanisms shall hold the adjustments and shall not be subject to inadvertent changes.

TS 45.5 Seat Structure and Materials

Cushions

Cushions shall be fully padded with at least 3 in. of materials in the seating areas at the bottom and back.

TS 45.6 Pedestal

Stainless steel pedestal shall be provided.

TS 45.7 Mirrors

TS 45.7.1 Exterior Mirrors

The bus shall be equipped with 2 exterior mirrors of unit magnification (flat), each with not less than 100 sq. in. of reflective surface. The mirrors shall be corrosion-resistant and have a non-reflective finish. Mirrors shall be installed with stable supports on each side of the bus and shall not vibrate so as to impair drivers' vision. The mirrors shall have spring loaded arms designed to permit mirror to be moved out of the way to preclude damage by automatic bus washing equipment. The mirrors shall be located so as to provide the operator a view to the rear along both sides of the bus and shall be adjustable both in the horizontal and vertical directions to view the rearward scene.

The curbside mirror shall be electrically remote controlled with a heavy duty four directional switch. The curbside mirror will also have a three inch convex mirror mounted in the lower right corner of the flat mirror. No part of the curbside mirror shall be within 80 inches from the ground.

The roadside rearview mirror shall be mounted lower on the bus body so that the operator's line of sight is not obstructed. The roadside mirror shall be adjustable by the seated driver or shall be electrically remote controlled.

All mirrors and brackets shall be B & R or approved equal.

All mirror locations must be approved by DTPW prior to production.

TS 45.7.2 Interior Mirrors

Mirrors shall be provided for the driver to observe passengers throughout the bus without leaving his seat and without shoulder movement. Interior mirrors shall not be in the line of sight to the right side exterior mirror.

Interior mirrors shall include a 4" x 16" rectangular flat driver's rearview mirror, a 6" convex front door area mirror at the front right corner near the ceiling, a 6" x 12" convex exit door area mirror, and a 6" round flat rear view relay mirror.

All mirror locations must be approved by DTPW prior to production.

WINDOWS

TS 46. General

A minimum of 10,000 sq in. of window area, including operator and door windows, shall be required on each side of the standard forty-foot configuration bus.

TS 47. Windshield

The two-piece windshield shall permit an operator's field of view as referenced in SAE Recommended Practice J1050. The vertically upward view shall be a minimum of 14 degrees, measured above the horizontal and excluding any shaded band. The vertically downward view shall permit detection of an object 3½ ft high no more than 2 ft in front of the bus. The horizontal view shall be a minimum of 90 degrees above the line of sight. Any binocular obscuration due to a center divider may be ignored when determining the 90-degree requirement, provided that the divider does not exceed a 3-degree angle in the operator's field of view. Windshield pillars shall not exceed 10 degrees of binocular obscuration. The windshield shall be designed and installed to minimize external glare as well as reflections from inside the bus. A one-piece windshield may be considered if a two-piece windshield is not available for the bus model.

The windshield shall be easily replaceable by removing zip-locks from the windshield retaining moldings. Bonded-in-place windshields shall not be used. Winglets may be bonded.

TS 47.1 Glazing

The windshield glazing material shall have a ¼ in. nominal thickness laminated safety glass conforming to the requirements of ANSI Z26.1 Test Grouping 1A and the Recommended Practices defined in SAE J673.

The upper portion of the windshield above the driver's field of view shall have a dark, shaded band with a minimum luminous transmittance of 5 percent when tested in accordance to ASTM D-1003.

TS 48. Driver's Side Window

The driver's side window shall be the sliding type, requiring only the rear half of sash to latch upon closing, and shall open sufficiently to permit the seated operator to easily adjust the street-side outside rearview mirror. When in an open position, the window shall not rattle or close during braking. This window section shall slide in tracks or channels designed to last the service life of the bus. The operator's side window shall not be bonded in place and shall be easily replaceable.

The driver's view, perpendicular through operator's side window glazing, should extend a minimum of 33 in. (840 mm) to the rear of the heel point on the accelerator, and in any case must accommodate a 95th percentile male operator. The view through the glazing at the front of the assembly should begin not more than 26 in. (560 mm) above the operator's floor to ensure visibility of an under-mounted convex mirror. Driver's window construction shall maximize ability for full opening of the window.

The driver window shall be glazed with THERMO GUARD or approved equal. The driver's glazing shall be ¼" thick laminated safety glazing conforming to FMVSS 205 and applicable requirements of ANSI Z26.1-1997. The total visible light transmittance must not be below 76 percent as measured by ASTM E-424. The LSG (light to solar gain ratio) must be a minimum of 1.28. The relative heat gain must meet a minimum requirement of 150 BTU/hr/sq.ft.

TS 49. Side Windows

TS 49.1 Configuration

Side windows shall not be bonded in place, but shall be easily replaceable without disturbing adjacent windows and shall be mounted so that flexing or vibration from engine operation or normal road excitation is not apparent. All aluminum and steel material will be treated to prevent corrosion.

TS 49.2 Emergency Exit (Egress) Configuration

All passenger windows shall be full fixed egress window assemblies with the exception of the driver window and destination window assemblies.

Each passenger windows shall be glazed with nominal ¼" tempered or laminated safety glass glazing material conforming to FMVSS 205 and applicable requirements of ANSI Z26.1-1997.

All aluminum and steel material will be black powder coated to help prevent corrosion. All passenger windows and driver's window shall be quick-change design.

Sacrificial Liner

Acrylic sacrificial liners shall be provided on all passenger windows. The liner shall be able to be replaced without removing the window from its installed position on the bus and without removing the tempered glazing from the sash. The exterior glazing shall be mounted securely in the existing window extrusion with or without the sacrificial liner installed in the window assembly. The removal of the sacrificial liner shall not prevent the vehicle from going back into service. Removal and replacement of the sacrificial liner shall not require the removal or the modification of any other parts or fasteners.

The Contractor shall submit calculations for compliance with emergency exit requirements to DTPW for approval at the pre-production design review.

TS 49.3 Configuration

All windows must meet FMVSS 205, FMVSS 302, and FMVSS 217 requirements. The destination window assembly shall be split fix with the transom glazing clear. All emergency handles shall be located on the right side of the window assemblies. Emergency exit and window release lever operation instructions must be metal and bolted to window frame rail adjacent to each seat. Emergency instructions must be printed in English, Spanish and Creole.

TS 49.4 Materials

Windows on the bus sides and in the rear door shall be tinted a neutral color, complementary to the bus exterior. The maximum solar energy transmittance shall not exceed 37 percent, as measured by ASTM E-424, and the luminous transmittance shall be no less than 16 percent, as measured by ASTM D-1003. Window at the destination/location sign shall not be tinted in the vicinity of the sign.

TS 49.5 Rear Window

No requirement for rear window.

HEATING, VENTILATING AND AIR CONDITIONING

TS 50. Capacity and Performance

The HVAC unit shall be an AC high-voltage electric-driven system with full hermetic A/C compressor, condenser fan, and evaporator blower motors. The unit furnished shall be supplied by the Thermo-King Corporation, or an approved equal.

The HVAC climate control system shall be capable of controlling the temperature and maintaining the humidity levels of the interior of the bus as defined in the following paragraphs.

The HVAC unit may either be roof or rear-mounted.

With the bus running at the design operating profile with corresponding door opening cycle, and carrying a number of passengers equal to 150 percent of the seated load, the HVAC system shall control the average passenger compartment temperature within a range between 65 and 80 °F, while maintaining the relative humidity to a value of 50 percent or less. The system shall maintain these conditions while subjected to any outside ambient temperatures within a range of 10 to 95 °F and at any ambient relative humidity levels between 5 and 50 percent.

When the bus is operated in outside ambient temperatures of 95 to 115 °F, the interior temperature of the bus shall be permitted to rise 0.5° for each degree of exterior temperature in excess of 95 °F.

When bus is operated in outside ambient temperatures in the range of -10 to 10 °F, the interior temperature of the bus shall not fall below 55 °F while the bus is running on the design operating profile.

System capacity testing, including pull-down/warm-up, stabilization and profile, shall be conducted in accordance to the APTA's "Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning System."

The recommended locations of temperature probes are only guidelines and may require slight modifications to address actual bus design. Care must be taken to avoid placement of sensing devices in the immediate path of an air duct outlet. In general, the locations are intended to accurately represent the interior passenger area.

Additional testing shall be performed as necessary to ensure compliance to performance requirements stated herein.

The air conditioning portion of the HVAC system shall be capable of reducing the passenger compartment temperature from 110 °F to 70 °F +/-3 °F in less than 30 minutes after system engagement for 30, 35 and 40-foot buses. Engine temperature shall be within the normal operating range at the time of start-up of the cool-down test, and the engine speed shall be limited to fast idle at ¾ max governed speed that may be activated by a driver-controlled device. During the cool-down period, the refrigerant pressure shall not exceed safe high-side pressures, and the condenser discharge air temperature, measured 6 in. from the surface of the coil, shall be less than 45 °F above the condenser inlet air temperature. No simulated solar load shall be used. There shall be no passengers on board, and the doors and windows shall be closed.

The contractor should submit test results with the proposal.

The air conditioning system shall meet these performance requirements using HFC R407C or approved equal.

Documentation proving that the pilot bus or first production bus (if no pilot bus available) meets or exceeds the system capacity testing in accordance to the APTA's "Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning System" shall be provided prior to delivery of the first bus.

A safety lanyard on overhead HVAC filter/return air grilles shall be provided.

The Air Conditioning unit installation shall be certified in writing by the vehicle manufacturer as being designed, manufactured, and installed in accordance with the HVAC manufacturer's requirements before acceptance and delivery of vehicles.

Special Tools and Equipment to Maintain the Air Conditioning System

Proposer should provide a complete listing of "All Special Tools and Equipment required to Maintain the air conditioning system" along with a complete listing of required tools and equipment needed to maintain the bus with the proposal.

Manufacturer shall supply all "Special Tools" prior to completion and delivery of first lot of buses if multiple bus builds are utilized.

Sets of Special Tools and Equipment required to maintain the air conditioning system should be priced separately from the bus in the Price Proposal. DTPW shall have the option to purchase up to fifteen (15) Sets of Special Tools.

Spare Parts and Components to Maintain the Air Conditioning System

Proposer should provide a complete and reasonable listing of all spare parts and components needed to maintain the air conditioning system. The listing shall contain pricing for each individual spare part and component as well as pricing for the complete set of spare parts and components.

All "Spare Parts and Components" shall have all the manufacturers latest improvements or design changes.

Sets of Spare Parts and Components Needed to Maintain the Air Conditioning System shall be priced separately from the bus in the Price Proposal. DTPW shall have the option to purchase up to twenty (20) Sets of Spare Parts and Components Needed to Maintain the Air Conditioning System and/or individual spare parts and components listed.

Special Training Required to Maintain Air Conditioning System

Contractor shall provide special Air Conditioning System Training to be conducted by the Air Conditioning system manufacturer at DTPW or a local facility in South Florida. This special training shall be more in-depth and detailed than the training provided by the bus manufacturer. Training shall include comprehensive diagnostics and repair of the air conditioning system components. The Contractor should provide a complete description of the Air Conditioning System manufacturer's training program with the proposal. Training classes shall consist of no more than (20) trainees per class.

Special Training Required to Maintain the Air Conditioning System shall be priced separately from the bus and from other specified training in the Price Proposal. DTPW shall have the option to purchase training for up to 50 trainees.

TS 51. Controls and Temperature Uniformity

The HVAC system excluding the driver's heater/defroster shall be centrally controlled with an advanced electronic/diagnostic control system with provisions for extracting/reading data. The system shall be compliant with J1939 Communication Protocol for receiving and broadcasting of data.

Hot coolant water shall be delivered to the HVAC system driver's defroster/heater and other heater cores by means of an auxiliary coolant pump, sized for the required flow, which is brushless and sealless having a minimum maintenance free service life for both the brushless motor and the pump of at least 40,000 hours at full power. An electric heated defroster may be considered as equal.

The climate control system shall be fully automatic and control the interior average temperature to within ±2 °F of specified temperature control set-point.

The temperature control set-point for the system shall be 72 °F.

The driver shall have full control over the defroster and driver's heater. The driver shall be able to adjust the temperature in the driver's area through air distribution and fans. The interior climate control system shall switch automatically to the ventilating mode if the refrigerant compressor or condenser fan fails.

Interior temperature distribution shall be uniform to the extent practicable to prevent hot and/or cold spots. After stabilization with doors closed, the temperatures between any two points in the passenger compartment in the same vertical plane, and 6 to 72 in. above the floor, shall not vary by more than 5 °F with doors closed. The interior temperatures, measured at the same height above the floor, shall not vary more than ± 5 °F from the front to the rear from the average temperature determined in accordance with APTA's "Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning System." Variations of greater than ± 5 °F will be allowed for limited, localized areas provided the majority of the measured temperatures fall within the specified requirement.

TS 52. Air Flow

TS 52.1 Passenger Area

The cooling mode of the interior climate control system shall introduce air into the bus at or near the ceiling height at a minimum rate of 25 cubic ft per minute (cfm) per passenger based on the standard configuration bus carrying a number of passengers equal to 150 percent of the seated load. Airflow shall be evenly distributed throughout the bus, with air velocity not exceeding 100 ft. per minute on any passenger. The ventilating mode shall provide air at a minimum flow rate of 20 cfm per passenger.

Airflow may be reduced to 15 cfm per passenger (150 percent of seated load) when operating in the heating mode. The fans shall not activate until the heating element has warmed sufficiently to ensure at least 70 °F air outlet temperature. The heating air outlet temperature shall not exceed 120 °F under any normal operating conditions.

The climate control blower motors and fan shall be designed such that their operation complies with the interior noise level requirements.

No "Fresh Air" Requirements. DTPW has an operating profile where the door opening cycle results in effectively providing an adequate "fresh air" mixture.

TS 52.2 Driver's Area

The bus interior climate control system shall deliver at least 100 cfm of air to the driver's area when operating in the ventilating and cooling modes. Adjustable nozzles shall permit variable distribution or shutdown of the airflow. Airflow in the heating mode shall be reduced proportionally to the reduction of airflow into the passenger area. The windshield defroster unit shall meet the requirements of SAE Recommended Practice J382, "Windshield Defrosting Systems Performance Requirements," and shall have the capability of diverting heated air to the driver's feet and legs. The defroster or interior climate control system shall maintain visibility through the driver's side window.

TS 52.3 Controls for the Climate Control System (CCS)

The controls for the driver's compartment for heating, ventilation and cooling systems shall be integrated and shall meet the following requirements:

- The heat/defrost system fan shall be controlled by a separate switch that has an "off" position and at least two positions for speed control. All switches and controls shall preclude the possibility of clothing becoming entangled, and shields shall be provided, if required. If the fans are approved by the Agency, an "on-off" switch shall be located to the right of or near the main defroster switch.
- A manually operated control valve shall control the coolant flow through the heater core.
- If a cable-operated manual control valve is used, the cable length shall be kept to a minimum to reduce cable seizing. Heater water control valves shall be "positive" type, closed or open. The method of operating remote valves shall require the concurrence of the Agency project manager.

TS 52.4 Driver's Compartment Requirements

A separate heating, ventilation and defroster system for the driver's area shall be provided and shall be controlled by the driver. The system shall meet the following requirements:

- The heater and defroster system shall provide heating for the driver and heated air to completely defrost and defog the windshield, driver's side window, and the front door glasses in all operating conditions. Fan(s) shall be able to draw air from the bus body interior and/or the exterior through a control device and pass it through the heater core to the defroster system and over the driver's feet. A minimum capacity of 100 cfm shall be provided. The driver shall have complete control of the heat and fresh airflow for the driver's area.
- The defroster supply outlets shall be located at the lower edge of the windshield. These outlets shall be durable and shall be free of sharp edges that can catch clothes during normal daily cleaning. The system shall be such that foreign objects such as coins or tickets cannot fall into the defroster air outlets. Adjustable ball vents or louvers shall be provided at the left of the driver's position to allow direction of air onto the side windows.

A ventilation system shall be provided to ensure driver comfort and shall be capable of providing fresh air in both the foot and head areas. Vents shall be controllable by the driver from the normal driving position. Decals shall be provided, indicating "operating instructions" and "open" and "closed" positions. When closed, vents shall be sealed to prevent the migration of water or air into the bus.

TS 52.5 Driver's Cooling

Driver's booster blower shall be provided.

TS 53. Air Filtration

Air shall be filtered before discharge into the passenger compartment. The filter shall meet the ANSI/ASHRAE 52.1 requirement for 5 percent or better atmospheric dust spot efficiency, 50 percent weight resistance, and a minimum dust holding capacity of 120 g per 1000 cfm cell. Air filters shall be easily removable for service.

Air filters shall be of disposable type.

TS 54. Roof Ventilators

Two roof ventilators shall be provided in the roof of the bus, one approximately over or just forward of the front axle and the other approximately over the rear axle. The Contractor may propose a single roof ventilator provided that calculations showing that the bus has sufficient egress area is submitted to DTPW for approval.

Each ventilator shall be easily opened and closed manually. When open with the bus in motion, this ventilator shall provide fresh air inside the bus. The ventilator shall cover an opening area no less than 425 sq in. and shall be capable of being positioned as a scoop with either the leading or trailing edge open no less than 4 in., or with all four edges raised simultaneously to a height of no less than 3½ in. An escape hatch shall be incorporated into the roof ventilator. Roof ventilator(s) shall be sealed to prevent entry of water when closed.

A tool shall be provided to manually open and close hatch.

TS 55. Maintainability

Manually controlled shut-off valves in the refrigerant lines shall allow isolation of the compressor and dehydrator filter for service. To the extent practicable, self-sealing couplings utilizing O-ring seals shall be used to break and seal the refrigerant lines during removal of major components, such as the refrigerant compressor. Shut-off valves may be provided in lieu of self-sealing couplings. The condenser shall be located to efficiently transfer heat to the atmosphere and shall not ingest air warmed above the ambient temperature by the bus mechanical equipment, or to discharge air into any other system of the bus. The location of the condenser shall preclude its obstruction by wheel splash, road dirt or debris. HVAC components located within 6 in. of floor level shall be constructed to resist damage and corrosion.

High and low refrigerant pressure electronic gauges to be located in the return air area.

TS 56. Entrance/exit area heating

No requirements for entrance/exit area heating.

TS 57. Floor-Level Heating

No requirements for floor-level heating.

EXTERIOR PANELS, FINISHES AND EXTERIOR LIGHTING

TS 58. Design

The bus shall have a clean, smooth, simple design, primarily derived from bus performance requirements and passenger service criteria. The exterior and body features, including grilles and louvers, shall be shaped to facilitate cleaning by automatic bus washers without snagging washer brushes. Water and dirt shall not be retained in or on any body feature to freeze or bleed out onto the bus after leaving the washer. The body and windows shall be sealed to prevent leaking of air, dust or water under normal operating conditions and during cleaning in automatic bus washers for the service life of the bus.

Exterior panels shall be sufficiently stiff to minimize vibration, drumming or flexing while the bus is in service. When panels are lapped, the upper and forward panels shall act as a watershed. However, if entry of moisture into the interior of the vehicle is prevented by other means, then rear cap panels may be lapped otherwise. The windows, hatches and doors shall be able to be sealed. Accumulation of spray and splash generated by the bus's wheels shall be minimized on windows and mirrors.

TS 58.1 Materials

Body materials shall be selected and the body fabricated to reduce maintenance, extend durability and provide consistency of appearance throughout the service life of the bus. Detailing shall be kept simple, and add-on devices and trim shall be minimized and integrated into the basic design.

TS 58.2 Roof-Mounted Equipment

A non-skid, clearly marked walkway or steps shall be incorporated on the roof to provide access to equipment without damaging any system or bus paneling.

TS 59. Pedestrian Safety

Exterior protrusions greater than 1/2 inches and within 80 inches of the ground shall have a radius no less than the amount of the protrusions. The left side rearview mirror and required lights and reflectors are exempt from the protrusion requirement. No part of the right side rear view mirror may be within 80 inches of the ground.

Exterior protrusions shall not cause a line-of-sight blockage for the driver.

Grilles, doors, bumpers and other features on the sides and rear of the bus shall be designed to minimize the ability of unauthorized riders to secure toeholds and handholds.

Exterior lights and audible warnings shall conform to the requirements found elsewhere in these Technical Specifications.

TS 60. Repair and Replacement

TS 60.1 Side Body Panels

Exterior body panels shall be stainless steel, aluminum, or fiberglass to resist rust and corrosion. Only exterior panels that are above the rubrail level may be structural components. Lower exterior panels shall be repairable or easily replaceable. If offered, lower exterior panels shall be removable resilient, impact resistant panels for protection against minor impacts and scratches.

Spare Body Parts Sets

The Proposer should provide a list of the most commonly used body parts with his proposal. The list shall include as a minimum:

Front and rear bumpers
Skirt panels
Front cap
Rear left and right corner panels
Compartment doors and hinges
Engine door
Windshields
Door panels and glazing
Window glazing

DTPW shall review the list and determine the parts and quantities that will be included in each Spare Body Parts Set. Spare Body Parts Sets shall be provided by the Contractor and shall be priced separately from the bus in the Price Proposal. DTPW shall have the option to purchase up to ten (10) Spare Body Parts Sets.

TS 61. Rain Gutters

Rain gutters shall be provided to prevent water flowing from the roof onto the side windows and passenger door. When the bus is decelerated, the gutters shall not drain onto the windshield, or driver's side window, or into the door boarding area. Cross sections of the gutters shall be adequate for proper operation, no less than 0.25 square inches.

TS 62. License Plate Provisions

Provisions shall be made to mount a standard size U.S. license plate per SAE J686 on the rear of the bus. These provisions shall flush mount or recess the license plate so that they can be cleaned by automatic bus washing equipment without being caught by the brushes. License plates shall be mounted at the lower center or lower street side of the rear of the bus and shall not allow a toehold or handhold for authorized riders.

TS 62.1 Rub rails

No requirement for rub rails.

TS 63. Fender Skirts

Features to minimize water spray from the bus in wet conditions shall be included in wheel housing design. Any fender skirts shall be unbreakable and easily replaceable. They shall be flexible if they extend beyond the allowable body width. Wheels and tire shall be removable without disturbing the fender skirts. Contractor may propose a design without fender skirts.

TS 64. Wheel covers

Wheel covers are not required.

TS 64.1 Splash Aprons

Splash aprons, composed of 1/4 inch minimum composition rubberized fabric, shall be installed behind each wheel and shall extend downward to within 3 inches of the road surface. Apron widths shall be no less than tire widths. Splash aprons shall be bolted to the bus under structure. Splash aprons and their attachments shall be inherently weaker than the structure to which they are attached. Splash aprons and their attachments shall not be included in the road clearance measurements. Other splash aprons shall be installed where necessary to protect bus equipment.

TS 65. Service Compartments and Access Doors

TS 65.1 Access Doors

Conventional hinged doors shall be used for the engine compartment and for all auxiliary equipment compartments including doors for checking the quantity and adding to the engine coolant, engine oil, and transmission fluid. Access openings shall be sized for easy performance of tasks within the compartment including tool operating space. Access doors shall be of rugged construction, and shall be capable of withstanding severe abuse throughout the life of the bus. They shall close flush with the body surface. All doors shall be hinged at the top or on the forward edge and shall be automatically prevented from coming loose or opening during transit service or in bus washer operations. All access doors shall be retained in the open position by props or counterbalancing with over center springs or pins. Doors with top hinges shall have safety props stored behind the door, on the door frame, or integral with the gas filled cylinders or springs. Hinges shall be stainless steel or rubber and shall last the service life of the bus. Springs shall be corrosion-resistant and shall last for the service life of the bus. Latch handles shall be flush with or recessed behind the body contour and shall be sized to provide an adequate grip for opening. Access doors, when opened, shall not restrict access for servicing other components or systems. Small access doors shall not incur damage if the door is opened up to 180 degrees so that it is folded flat against the bus body. Large access doors shall hinge up and out of the way or fold flat against the bus body and shall be easily opened by one person. A counter-balance, spring, or gas cylinder system shall assist opening large doors. Gas cylinders shall be used in pairs located on both ends of the door.

If precluded by design, the manufacturer should provide door design information specifying how the requirements are met.

TS 65.2 Access Door Latch/Locks

Requirement for Latches on Access Doors

Major access doors shall be equipped with locks requiring a nominal 5/16 inch, square end tool to open. The locks shall be standardized so that only one tool is required to open all major access doors on the bus. The lock for the engine compartment door shall latch automatically when the door is shut.

TS 66. Bumpers

TS 66.1 Location

Bumpers shall provide impact protection for the front and rear of the bus with the top of the bumper being 27 in., ± 2 in., above the ground. Bumper height shall be such that when one bus is parked behind another, a portion of the bumper faces will contact each other.

TS 66.2 Front Bumper

Front bumper shall be black Romeo Rim (or approved equal) "Help" type energy absorbing bumper system with anti-ride slope feature and wrap around ends to protect all corners. Construction shall be a polyurethane elastomer shell material, to provide for high tear resistance, tensile strength puncture resistance, and low temperature flexibility. It shall be filled with a controlled cellular polyurethane foam.

Characteristics shall be:

Flexural Modules	225,000 psi ambient 95,000 psi at 120 degrees C, ASTM method D790.
Tensile Strength	5,000 psi minimum, ASTM method D638, D412.
Elongation	550% minimum, ASTM method D412.
Durometer	85-87 shore minimum, ASTM method D2240.
Tear Strength	1,000 psi minimum
Cold Flex	Minimum 1/4" Mandrel after 12 hours at -60 degrees F.
Puncture Resistance	750 pounds minimum, SAE method J918C.

Bumper height, with the bus at normal ride height, shall be 28 ± 2 inches to the top of the bumper. Bumper height shall be such that when one bus is parked behind another, a portion of the bumper faces will contact each other.

The bumper shall be independent of all power systems of the bus and shall not require service or maintenance in normal operation during the service life of the bus.

Bike Rack

An exterior bright stainless steel, three position bike rack, Sportworks Apex 3, or approved equal shall be installed on the front bumper of each bus. Decals containing operating instructions in Creole, Spanish, and English language shall be provided on each rack. A quick release bracket shall be provide to remove and replace the bike rack.

TS 66.3 Rear Bumper

Rear bumper shall be black Romeo Rim (or approved equal) "Help" type energy absorbing bumper system with anti-ride slope feature and wrap around ends to protect all corners. Construction shall be a polyurethane elastomer shell material, to provide for high tear resistance, tensile strength puncture resistance, and low temperature flexibility. It shall be filled with a controlled cellular polyurethane foam.

Characteristics shall be:

Flexural Modules	225,000 psi ambient 95,000 psi at 120 degrees C, ASTM method D790.
Tensile Strength	5,000 psi minimum, ASTM method D638, D412.
Elongation	550% minimum, ASTM method D412.
Durometer	85-87 shore minimum, ASTM method D2240.
Tear Strength	1,000 psi minimum
Cold Flex	Minimum 1/4" Mandrel after 12 hours at -60 degrees F.
Puncture Resistance	750 pounds minimum, SAE method J918C.

Bumper height, with the bus at normal ride height, shall be 28 ± 2 inches to the top of the bumper. Bumper height shall be such that when one bus is parked behind another, a portion of the bumper faces will contact each other.

The bumper shall be independent of all power systems of the bus and shall not require service or maintenance in normal operation during the service life of the bus.

TS 66.4 Bumper Material

Bumper material shall be corrosion-resistant and withstand repeated impacts of the specified loads without sustaining damage. Visible surfaces shall be black. These bumper qualities shall be sustained throughout the service life of the bus.

TS 67. Finish and Color

TS 67.1 Appearance

All exterior surfaces shall be smooth and free of wrinkles and dents. Exterior surfaces to be painted shall be properly prepared as required by the paint system Supplier prior to application of paint to assure a proper bond between the basic surface and successive coats of original paint for the service life of the bus. Drilled holes and cutouts in exterior surfaces shall be made prior to cleaning, priming and painting, where possible, to prevent corrosion. The bus shall be completely painted prior to installation of exterior lights, windows, mirrors and other items that are applied to the exterior of the bus. Body filler materials may be used for surface dressing, but not for repair of damaged or improperly fitted panels.

Paint shall be applied smoothly and evenly with the finished surface free of visible dirt and the following other imperfections:

- blisters or bubbles appearing in the topcoat film
- chips, scratches, or gouges of the surface finish
- cracks in the paint film
- craters where paint failed to cover due to surface contamination
- overspray
- peeling
- runs or sags from excessive flow and failure to adhere uniformly to the surface
- chemical stains and water spots
- dry patch due to incorrect mixing of paint activators
- buffing swirls

All exterior finished surfaces shall be impervious to diesel fuel, gasoline and commercial cleaning agents. Finished surfaces shall resist damage by controlled applications of commonly used graffiti-removing chemicals.

Proper adhesion between the basic surface and successive coats of the original paint shall be measured using an Elcometer adhesion tester as outlined in ASTM D4541-85. Adhesion shall be a minimum 300 ft-lbs. The bus manufacturer shall supply test samples of the exterior surface for each step of the painting process that may be subject to adhesion testing per ASTM G4541-87 and ASTM D4145-85. ASTM D4541-93 may be used for inspection testing during assembly of the vehicle.

The bus exterior shall be painted with a PPG epoxy primer, 1-1.5 mils dry film, and a PPG DGHS graffiti resistant topcoat, minimum 2 mils dry film. A comparable Dupont paint system will be accepted as approved equal.

The exterior finish shall meet the following requirements:

SPECIFICATION	TEST METHOD
Salt Spray Resistance - Minimum 500 hours	ASTM B117
Adhesion - 90%	ASTM D3359-93 Method B
Humidity Resistance - 90% after 24 hr. recovery	ASTM D1735
Impact Resistance - No cracking at 40 lbs.	ASTM D2794
Film Hardness by Pencil Test - Minimum HB-F hardness	ASTM D3363
Accelerated Weathering by UV - 85% gloss retention after 500 hours QUV	ASTM D4587
Specular Gloss - 90 plus using 20 degree gloss meter	ASTM D523-89

Proposers should submit Test Reports or Certifications of Compliance for the paint products that will be supplied, with their Requests for Approved Equals.

Proposers are requested to propose dramatic and contemporary color schemes and graphics for the exterior of the bus. The predominant colors that must be used in the design of graphics are blue and green. (PMS numbers for colors to be issued by addendum at a later date.) No specific colors are required as a background color on the exterior of the bus or the interior of the bus. Striping and graphics shall not be silk-screened.

TS 68. Decals, Numbering and Signing

Monograms, numbers and other special signing shall be applied to the inside and outside of the bus as required. Signs shall be durable and fade-, chip- and peel-resistant. They may be painted signs, decals or pressure-sensitive appliqués. All decals shall be installed per the decal Supplier recommendations. Signs shall be provided in compliance with the ADA requirements defined in 49 CFR Part, Subpart B, 38.27.

Contractor shall furnish and apply all decals. Final sizes and locations shall be approved by DTPW. Contractor should provide the list of all decals, including samples or drawings of all listed decals, for DTPW

approval prior to production. Trilingual (English, Spanish, and Creole) instructions for decals containing identification of windows, hatches, etc., shall be provided.

Logo

A “Miami-Dade County” logo must be incorporated into the graphics to be used on the exterior of the bus. The logo must be displayed, at minimum, on the curb side of the bus and the front of the bus. The colors to be used in the logo are blue and green. (PMS numbers for colors to be issued by addendum at a later date). Sample logo to be provided by DTPW prior to production of buses.

Bus Numbering

A five-digit identification number assigned to the vehicle by DTPW will be placed by the Contractor below the front windshield on the right side of the front panel, over front entry door, over driver's window, at the left and right side near the rear of the bus, and on the top curbside of the rear. Decal vehicle numbers shall be 4" high Helvetica Bold black on the sides and front, white on the rear. The vehicle identification number shall be painted on the roof of the bus using black 24” Swis721 Bt numerals.

Decals shall be provided in compliance with the ADA requirements defined in 49 CFR Part 38, Subpart B, 38.27. A “Wheelchair” decal with a blue background and white wheelchair symbol shall be placed on or adjacent to the wheelchair ramp door. A decal with a blue background, white wheelchair symbol, white lettering, and bilingual instructions “Please allow w/c customers passengers to board/exit first” shall be placed by the passenger door. A “Kneeling Bus” bilingual decal with black letters on yellow background shall be placed adjacent to the entry door below the windows.

A “People’s Transportation Plan” decal will be required in three locations on the bus. A sample will be provided by DTPW prior to production of buses.

“People’s Transportation Plan” decal

A decal indicating the location of the master battery switch shall be located on the exterior access panel.

A detailed signs and decals description shall be submitted to DTPW for review and approval prior to production.

Material

Exterior graphics material shall be 3M Scotchlite Reflective Sheeting Series 690 with Controltac adhesive. Film shall be pigmented. Silk-screened decals will not be acceptable.

Application material shall be 3M Application Tape, SCPM-3.

Prespacing material shall be 3M Prespacing Tape, SCPS-2.

Other Decals

The contractor shall provide interior signage and mechanical compartment signage. Final wording and exact location and placement will be determined prior to production.

The following is a draft list of informational decals required by DTPW. A final list will be approved prior to production.

English - Priority Seating For seniors and riders with disabilities.
Federal law requires that these seats must be relinquished upon request.

Spanish - Asientos para el uso de personas mayores o incapacitadas.
La ley federal requiere que estos asientos sean sedidos sobre el pedido.

Creole - Plas Rezève Pou pasaje grandèt ak pasaje enfim yo.
Lalwa federal egzije ke yo sede syèj sa yo bay moun sou demann.


Priority Seating
For seniors and riders with disabilities
Asientos para el uso de personas mayores o incapacitadas
Plas Rezève
Pou pasaje grandèt ak pasaje enfim yo

English- Watch Your Step

Spanish - Precaucion al subir

Creole - Atansyon Eskalye

English - Stand Behind Yellow Line While Bus Is In Motion

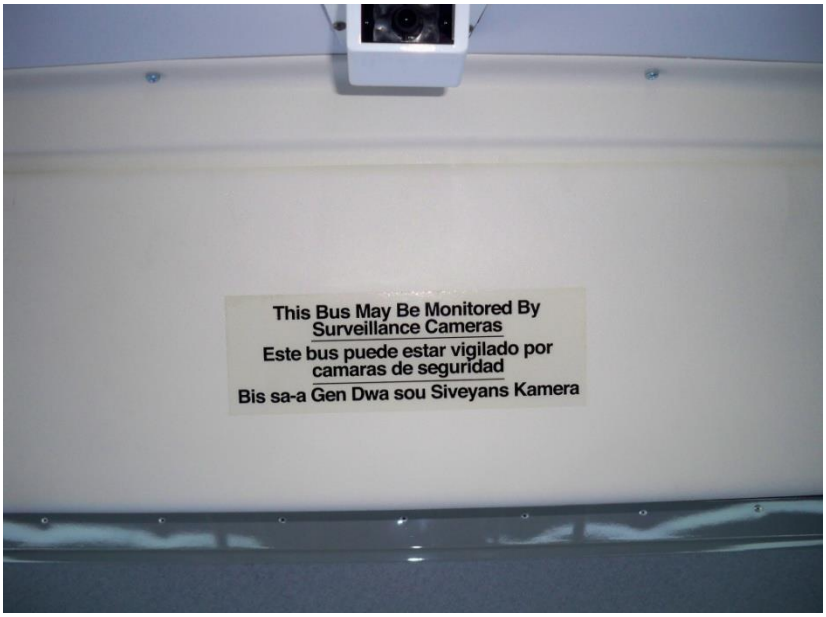
Spanish - Permanezca detras de la linea amarilla mientras el autobus este en movimiento

Creole - Rete Kanpe Dèyè Liy Jòn la Lè Bis la ap Deplase

English - This Bus May Be Monitored By Surveillance Cameras

Spanish -Este bus puede estar vigilado por camaras de seguridad

Creole - Bis sa-a Gen Dwa sou Siveyans Kamera



English - Push Button For Next Stop

Spanish - Para indicar su parada oprima el boton

Creole - Peze Bouton an Pou Pwochen Estòp la

English - Wait For Green Light
Then Touch Door To Open

Spanish - Espere por la luz verde, entonces toque la puerta para abrirla

Creole - Tann Limyè Vèt la
Epi Manyen Pòt la Pou Ouvè li

English - Emergency Exit Instruction

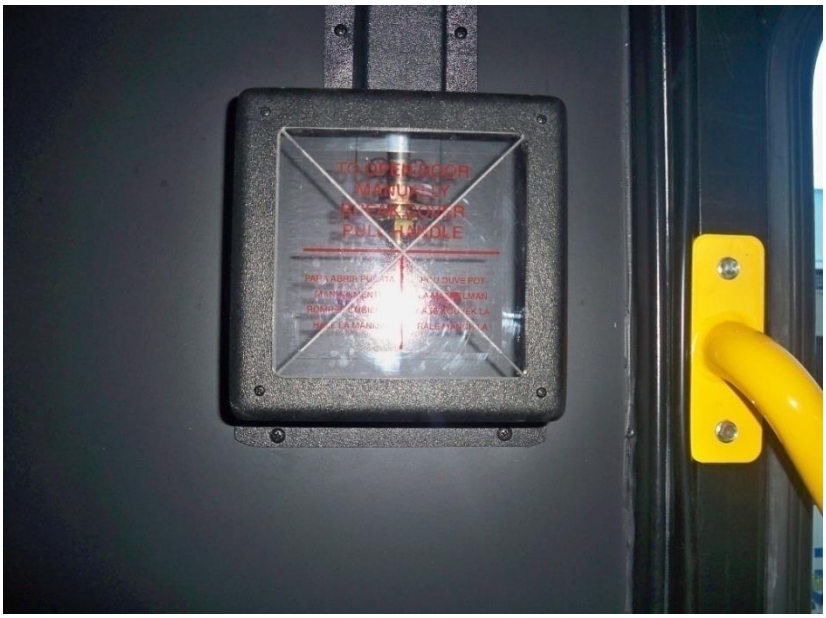
Spanish - Salida de emergencia instruccion

Creole - Enstriksyon Pou Sòti Dijans

English - To Open Door Manually
Break Cover
Pull Handle

Spanish - Para Abrir la puerta manualmente
Romper Cubierta
Hale la Manija

Creole - Pou Ouvè Pòt la Manyèlman
Kase Kouvèk la
Rale Manch la



English - To Open Door Manually
Break Cover
Turn Handle

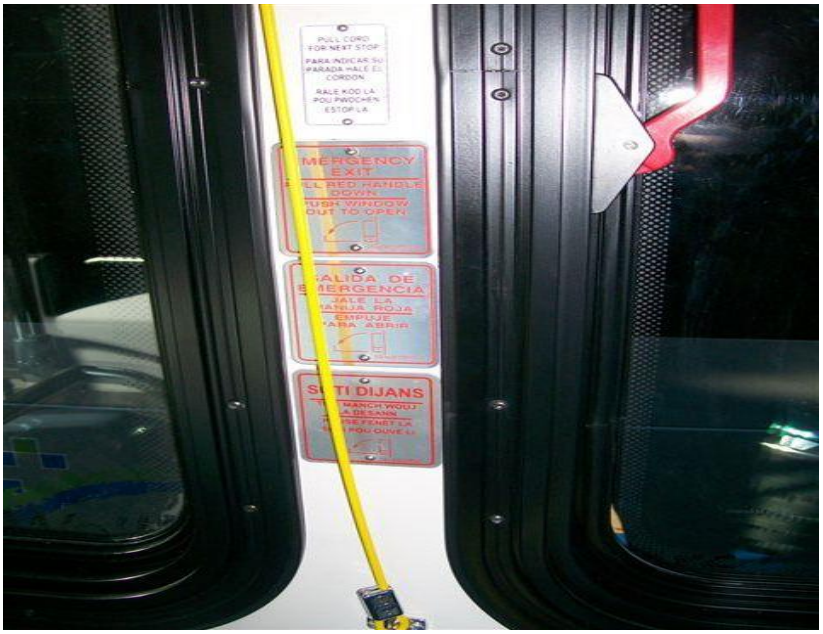
Spanish - Para Abrir la puerta manualmente
Romper Cubierta
Gire la Manija

Creole - Pou Ouvè Pòt la Manyèlman
Kase Kouvèk la
Tounen Manch la

English - Emergency Exit

Spanish - Salida de emergencia

Creole -Sòti Dijans



English - Pull Cord For Next Stop

Spanish - Para indicar su parada hale el cordon

Creole -Rale Kòd La Pou Pwochen Estòp la

English - Please allow customers in wheelchairs to board and exit first –

Spanish - Permita que usuarios en sillas de ruedas entren y salgan primero.

Creole -Tanpri kite kliyan ki nan chèz woulant yo monte oswa desann anvan

English – Pull Red Handle Down and Hold While Pushing Window Out at Bottom
Spanish – Jale la manija roja y sostengala mientras empuja la parte de abajo de la ventana
Creole – Pouse ak kenbe manch wouj la desann pandan wap pouse anba fenet la

English -Kneeling Bus

Spanish- Autobus Inclinable

Creole - Bis ki Desann Ba

English- Caution: Do Not Stand In Designated Area
Do Not Lean Against Door

Spanish - Cuidado: No Se Pare en el Areadesignada
No Se Apoye Contra La Puerta

Creole – Atansyon: Pa Kanpe Nan Zon Ki Dezinyen Yo
Pa Apiye Sou Pòt La

English – Exit Door

Spanish – Puerta de Salida

Creole –Pòt Sòti

Curbside Wheelhouse

English only:

No Sitting Or Objects In This Area

Bike Rack Decals :

English:

1. Squeeze And Pull
2. Put Front Wheel Here
3. Rotate Handle, Pull Handle To Stow

Spanish:

1. Apriete y Levante
2. Ponga La Rueda Delantera Aqui
3. Gire La Manija, Jale La Manija Para Guardar

Creole:

1. Peze Epi Tire
2. Mete Wou Devan Yo La A
3. Vire Manch La Tounen, Tire Manch La Pou Ranje Bisiklèt

Wheelchair Ramp Metallic Placard:

English only:

RAMP INSTALLATION MEETS STATE OF
FLORIDA MINIMUM REQUIREMENTS

TS 68.1 Passenger Information

ADA priority seating signs as required and defined by 49 CFR, Part 38.27 shall be provided to identify the seats designated for passengers with disabilities.

Requirements for a public information system in accordance with 49 CFR, Part 38.35 shall be provided.

TS 69. Exterior Lighting

Exterior lighting and reflectors shall comply, as applicable, with Part 393, Subpart B of the FMCSA and FMVSS 108.

All exterior lights must be of a waterproof design and meet U.S. /DOT requirements. Commercially available LED-type lamps shall be utilized at all exterior lamp locations. Lamps, lenses and fixtures shall be interchangeable to the extent practicable. Two hazard lamps at the rear of the bus shall be visible from behind when the engine service doors are opened. Light lenses shall be designed and located to prevent damage when running the vehicle through an automatic bus washer. Front marker (clearance) lights along with lights located on the roof and sides of the bus shall have protective shields or be of the flush mount type to protect the lens against minor impacts.

All exterior lights with the exception of the headlamps shall be Dialight LED potted, shock protected lamps, or approved equal. The lights shall have a remote ground. The light shall be sealed to prevent entry and accumulation of moisture or dust. Each lamp shall be replaceable in less than 5 minutes. Lamps and fixtures shall be interchangeable to the extent practicable.

Two 4" minimum combination stop and tail lights and two 4" minimum amber directional signal lights, both Dialight LED or approved equal, shall be provided at rear of bus. In addition to the standard rear directional signals, upper directional signals shall be mounted at least eight feet (8') above the street. Upper signals shall be minimum four inches (4") diameter amber LED.

Identification lights (Michigan marker lights, individual type) shall be mounted at the front and rear center of the roof crown panels. Front lights shall be amber LED and rear lights shall be red LED. All marker lights must be designed so that water will not intrude into the interior of the bus.

Four roof marker lights shall be installed. The LED marker lights at the front and rear upper corner of the coach shall be flush mounted type to preclude breakage by the three limbs, coach washer, etc. The two forward lights shall be amber LED, the two rear lights shall be red LED.

Wheelchair ramp service area lights shall be white LED and shall conform to ADA requirements 49 CFR Part 38, Subpart B, Sec.38.31 Lighting (a) Any stepwell or doorway immediately adjacent to the driver shall have, when the door is open, at least 2 foot-candles of illumination measured on the step tread or lift platform b) Other stepwells and doorways, including doorways in which lifts or ramps are installed, shall have, at all times, at least 2 foot- candles of illumination measured on the step tread, or lift or ramp, when deployed at the vehicle floor level.

TS 69.1 Backup Light/Alarm

Two (2) white LED back-up lights shall be provided and controlled automatically by the reverse gear selector. Visible and audible warning shall inform following vehicles or pedestrians of reverse operation. Visible reverse operation warning shall conform to SAE Standard J593. Audible reverse operation warning shall conform to SAE Recommended Practice J994-Type C or D. Back-up lamps shall be Dialight LED, or approved equal.

TS 69.2 Doorway Lighting

Lights at the front and rear passenger doorways and curb lights shall comply with ADA requirements. The lights shall activate only when the doors open and the master run switch is in the “Night Run” or “Lights” positions and shall illuminate the street surface to a level of no less than 1 foot candle for a distance of 3 feet outward from the step tread edge. The lights shall be in accordance with the latest provisions of 49 CFR 609.15. Lights shall be shielded to protect passengers' eyes from glare.

TS 69.3 Turn Signals

Turn-signal lights shall be provided on the front, rear, curb and street sides of the bus in accordance with FMVSS 108 and Part 393, Subpart B of the FMCSA as applicable and shall be of the armored LED type with amber lenses. The side turn signals shall be located opposite each other and in line.

Directional signals shall be operated by self-canceling momentary foot switches (left, right, or both) or pedestal type housing on the left of the steering column. Directional signal tell-tale lights shall be located on dash. Flasher operation shall be controlled by the bus multiplex system. In addition to the momentary foot switch, a heavy duty toggle switch or rocker switch near the door control shall activate the hazard warning lights. Hazard warning lights shall operate automatically with the engine run switch on, when the transmission is in gear and the door is open.

Two hazard lamps at the rear of the bus shall be visible from behind when the engine service doors are opened.

TS 69.4 Headlights

Headlights shall be LED. Headlamps shall be designed for replacement without removing the headlamp bezel. Standard OEM headlight installation shall be provided in accordance with FMVSS 108 and Part 393, Subpart B of the FMCSA as applicable.

Headlamps shall incorporate a daytime running light feature.

TS 69.5 Brake Lights

Brake lights shall be provided in accordance with FMVSS 108 and Part 393, Subpart B of the FMCSA as applicable.

Bus shall include red, high and center mount brake lamp(s) along the backside of the bus in addition to the lower brake lamps required under FMVSS 108. The high and center mount brake lamp(s) shall illuminate steady with brake application.

TS 69.6 Service Area Lighting (Interior and Exterior)

LED lamps shall be provided in the engine and all other compartments where service may be required to generally illuminate the area for night emergency repairs or adjustments. These service areas shall include, but not be limited to, the engine compartment, the communication box, junction/apparatus panels and passenger door operator compartments. Lighting shall be adequate to light the space of the service areas to levels needed to complete typical emergency repairs and adjustments. The service area lamps shall be suitable for the environment in which they are mounted.

Engine compartment lamps shall be controlled by a switch mounted near the rear start controls. All other service area lamps shall be controlled by switches mounted on or convenient to the lamp assemblies. Power to the service area lighting shall be programmable. Power shall latch on with activation of the switch and shall be automatically discontinued (timed out) after 30 minutes to prevent damage caused by inadvertently leaving the service area lighting switch in the on position after repairs are made.

INTERIOR PANELS AND FINISHES

TS 70. General Requirements

Materials shall be selected on the basis of maintenance, durability, appearance, safety, flammability and tactile qualities. Materials shall be strong enough to resist everyday abuse and be vandalism and corrosion resistant.

This interior shall be generally pleasing, simple, modern, and free from superficial design motifs. It shall have no sharp depressions or inaccessible areas and shall be easy to clean and maintain. To the extent practicable, all interior surfaces more than 10 inches below the lower edge of the side windows or windshield shall be shaped so that objects placed on them fall to the floor when the bus is parked on a level surface.

Handholds, lights, air vents, armrests, and other interior fittings shall appear to be integral with the bus interior. Trim and attachment details shall be kept simple and unobtrusive. Interior trim shall be secured to avoid resonant vibrations under normal operational conditions. There shall be no sharp, abrasive edges and surfaces and no unnecessary hazardous protuberances.

TS 71. Interior Panels

Panels shall be easily replaceable and tamper-resistant. They shall be reinforced, as necessary, to resist vandalism and other rigors of transit bus service. Individual trim panels and parts shall be interchangeable to the extent practicable.

Materials shall be selected on the basis of maintenance, durability, appearance, safety, flammability, and tactile qualities. Materials shall be strong enough to resist everyday abuse and vandalism and shall be resistant to scratches and markings.

All plastic and synthetic materials used inside the bus shall be fire resistant to comply with FMVSS-302.

Materials used in the construction of the Passenger Compartment of the bus shall be in accordance with the Recommended Fire Safety Practices defined in FTA Docket 90A, dated October 20, 1993. Materials entirely enclosed from the passenger compartment, such as insulation within the sidewalls, and smaller components and items, such as switch knobs and small light lenses, shall be exempted from this requirement.

The Contractor shall certify that combustible materials to be used in the construction of these buses have been tested by a recognized testing laboratory and that the results are within the recommended limits as specified by the Federal Transit Administration.

Interior panels may be integral with, or applied to, the basic bus structure. They shall be decorated in accordance with the interior specified. Use of moldings and small pieces of trim shall be minimized, and all parts shall be functional.

Interior panels shall be attached so that there are no exposed edges or rough surfaces. Panels and fasteners shall not be easily removable by passengers. Interior trim fasteners, where required, shall be rivets or cross-recessed head screws.

Where doors open inward (slide glide), barriers shall prevent passengers from standing where they could be struck by an opening door.

TS 71.1 Driver Area Barrier

An operator’s area barrier shall be provided for the driver's security and personal protection. The barrier shall enclose the driver and prevent passengers from reaching the driver or the driver's personal effects.

A rear barrier between the driver and the left front passenger seat shall extend from the floor level to the ceiling. A side barrier enclosure door shall be located on the right side of the driver's area extending from the rear barrier forward. A door shall allow for easy access into and out of the driver's area. The exterior skin of the barrier shall be constructed of stainless steel with a slight corrugated texture or other architecturally pleasing finish approved by DTPW. The operator's barrier shall be constructed so as to prevent unauthorized entry or intrusion into the driver's area, yet allow the driver to converse with passengers. All passenger seat positions shall be visible to the driver either directly or by mirror. The barrier shall not hinder the driver's performance in any manner. It shall not be a source of any rattling or noise. The enclosure door shall be secured from the inside and the latch to open the door shall be flush mounted so that clothing or other articles cannot be caught on it. A handle shall be provided on the inside of the door to assist the driver in opening and closing the door. The door shall be equipped with a spring or other device to automatically return the door to the closed position. The enclosure door shall be a fixed ½" polycarbonate panel which will not interfere with the driver's view through the front windshield or the rear view mirrors. The door panel shall not reflect glare at the driver or cast glare onto the windshield. The door panel shall be covered on both sides with a removable clear scratch guard, 3M Scotchgard Multi-Layer Protective Film -1004MS or approved equal. Driver's area trim shall be satin black. The barrier shall eliminate glare from interior lighting during night operation. A driver's personal effects box approximately 20" W x 15" H x 10" D shall be incorporated into the operator's barrier. The Contractor should submit concept drawings, for evaluation of the proposed barrier, at the time of Requests for Approved Equals. The Contractor must obtain DTPW's approval of the concept drawings prior to Bid Submittal. Prior to production of the pilot bus, a full scale mockup of the driver's compartment area shall be constructed for DTPW approval of the operator's barrier design.

TS 71.2 Modesty Panels

Sturdy divider panels constructed of durable, unpainted, corrosion-resistant material complementing the interior trim shall be provided to act as both a physical and visual barrier for seated passengers. Modesty panels shall be located at doorways to protect passengers on adjacent seats, and along front edge of rear upper level. Design and installation of modesty panels located in front of forward facing seats shall include a handhold/grabhandle along its top edge. These dividers shall be mounted on the sidewall and shall project toward the aisle no farther than passenger knee projection in longitudinal seats or the aisle side of the transverse seats. Modesty panels shall extend no higher than the lower daylight opening of the side windows and those forward of transverse seats shall extend downward to a level between 1-1/2 and 1 inches above the floor. Panels forward of longitudinal seats shall extend to below the level of the seat cushion. Dividers positioned at the doorways shall provide no less than a 2-1/2-inch clearance between the modesty panel and the opened door to protect passengers from being pinched. Modesty panels installed at doorways shall be equipped with grab rails. The modesty panel and its mounting shall withstand a static force of 250 pounds applied to a four-inch by four-inch area in the center of the panel without permanent visible deformation.

Weather shields of clear ½" polycarbonate shall be installed forward of the rear exit door above the seat back. The clear weather shield shall be covered on both sides with a removable clear scratch guard, 3M Scotchgard Multi-Layer Protective Film -1004MSor approved equal.

TS 71.3 Front End

The entire front end of the bus shall be sealed to prevent debris accumulation behind the dash and to prevent the driver from kicking or fouling wiring and other equipment with his feet. The front end shall be free from protrusions that are hazardous to passengers standing or walking in the bus during rapid decelerations. Paneling across the front part of the bus and any trim around the driver's compartment shall be formed metal or plastic material. Formed metal dash panels shall be painted and finished to exterior quality. Plastic dash panels shall be vandal-resistant, replaceable, and reinforced to support dash mounted communications and fare collection equipment required by DTPW. All colored, painted and plated parts forward of the driver's barrier shall be finished with a dull matte black color.

TS 71.4 Rear Bulkhead

The rear bulkhead and rear interior surfaces shall be materials suitable for exterior skin, painted and finished to exterior quality, or paneled with melamine type material or plastic, and trimmed with stainless steel, anodized aluminum, or plastic. Colors, patterns, and materials shall match or coordinate with the balance of the bus interior.

The rear bulkhead paneling shall be contoured in such a way that it shall not have a tendency to collect trash. Any air vents in this area shall be louvered to reduce air flow noise and to reduce the probability of trash or litter being thrown or drawn through the grille. The panel, or sections thereof, shall be removable to service components located on the rear bulkhead.

TS 71.5 Headlining

Headlining panels shall be white melamine or approved equal. Headlining shall be supported to prevent buckling, drumming, or flexing and shall be secured without loose edges. Headlining materials shall be treated or insulated to prevent marks due to condensation where panels are in contact with metal members. Moldings and trim strips, as required to make the edges tamperproof, shall be stainless steel, aluminum, or plastic, colored to complement the ceiling material. Headlining panels covering operational equipment that is mounted above the ceiling shall be on hinges for ease of service, but retained to prevent inadvertent opening.

TS 71.6 Fastening

Interior panels shall be attached so that there are no exposed unfinished or rough edges or rough surfaces. Fasteners should be corrosion resistant. Panels and fasteners shall not be easily removable by passengers. Exposed interior fasteners should be minimized, and where required shall be tamper-resistant.

TS 71.7 Insulation

Any insulation material used between the inner and outer panels shall minimize the entry and/or retention of moisture. Insulation properties shall be unimpaired during the service life of the bus. Any insulation material used inside the engine compartment shall not absorb or retain oils or water and shall be designed to prevent casual damage that may occur during maintenance operations.

The combination of inner and outer panels on the sides, roof, wheel wells and ends of the bus, and any material used between these panels, shall provide a thermal insulation sufficient to meet the interior temperature requirements. The bus body shall be thoroughly sealed so that the driver or passengers cannot feel drafts during normal operations with the passenger doors closed.

Insulation shall meet the requirements of FMVSS 302.

All insulation materials shall comply with the Recommended Fire Safety Practices defined in FTA Docket 90-A, dated October 20, 1993.

TS 71.8 Floor Covering

The floor covering shall have a non-skid walking surface that remains effective in all weather conditions and complies with all ADA requirements including Part 38, Subpart B, Sec. 38.25 Doors, steps and thresholds: *(a) Slip resistance. All aisles, steps, floor areas where people walk and floors in securement locations shall have slip-resistant surfaces. (b) Contrast. All step edges, thresholds and the boarding edge of ramps or lift platforms shall have a band of color(s) running the full width of the step or edge which contrasts from the step tread and riser, or lift or ramp surface, either light-on-dark or dark-on-light.*

The floor covering shall be vinyl highly slip resistant, durable, resilient, UV and oil resistant, and shall resist abrasion and wear. The floor covering shall be designed for ease of maintenance and cleaning, and shall last the life of the bus with a minimum 12 year warranty.

The floor covering, as well as transitions of flooring material to the main floor and to the entrance and exit area, shall be smooth and present no tripping hazards. Seams shall be sealed/welded per manufacturer's specifications. The floor covering material shall be minimum 2.7mm thick.

The floor covering color and pattern will be selected prior to production. The floor color and pattern shall be consistent throughout the bus except step nosings, step treads, standee line and other areas requiring contrasting markings as noted.

Entry and Exit Door Areas
The outboard edge of the entrance door and exit door area floor covering shall have a yellow step nosing approximately three inches deep and the full width of the entrance door and exit door step treads.

Interior Step (if applicable)
The center aisle interior step landing between the lower and upper floors shall be entirely yellow. The step nosing of the upper floor shall be yellow, approximately three inches deep, and the full width of the top step tread

Standee Line
A yellow standee line shall extend across the bus aisle immediately aft of the entry vestibule area. The standee line shall be approximately 2½ inches wide and shall extend between the driver's barrier and the front curbside wheelhouse or front door modesty panel.

Operator's Platform
A yellow step nosing approximately two inches wide shall extend along the entire edge of the operator's platform.

Safety Markings
Any areas on floor, which are not intended for standees, such as but not limited to areas "swept" during passenger door operation, on inward sweeping doors, shall be clearly and permanently marked.

Floor Covering Installation:

All floor covering edges except level butted/welded edges shall be protected by stainless steel or clear anodized aluminum trim.

The floor covering material shall be free of bubbles, scratches, gouge marks, and discoloration.

TS 71.9 Interior Lighting

The light source shall be located to minimize windshield glare, with distribution of the light focused primarily on the passengers' reading plane while casting sufficient light onto the advertising display. The lighting system may be designed to form part of or the entire air distribution duct.

The interior lighting system shall be the I/O Control LED based Dinex Lighting System or approved equal.

The lens material shall be translucent polycarbonate. Lenses shall be designed to effectively "mask" the light source. Lenses shall be sealed to inhibit incursion of dust and insects yet be easily removable for service. Access panels shall be provided to allow servicing of components located behind light panels. If necessary, the entire light fixture shall be hinged.

TS 71.10 Passenger

The following indications for interior lights shall be used to eliminate glare in the driver's area and on the windows:

Interior lights shall be controlled by a three- position switch. When the switch is in the "OFF" position, all interior lights are extinguished regardless of the master run switch position. When "ON", all interior lights are illuminated regardless of the master run switch position. When in "NORMAL" with the master run switch in "NIGHT RUN", the lamps are all illuminated when the entry door is OPEN. When in "NORMAL" with the master run switch in "NIGHT RUN", the first and second curbside module of interior lights and the first roadside module of interior light shall be designed as to automatically extinguish when the entry door is closed.

A description of the feature used for the first light modules extinguish when the front door opens shall be submitted to DTPW for review and approval prior to production.

The floor surface in the aisle shall be illuminated to no less than 10 foot-candles. Floor surface in the vestibule shall be illuminated to no less than 4 foot-candles with the front door open and to no less than 2 foot-candles with the front door closed. Fluorescent lighting shall not be installed above the driver's side window and the front door. Lamp fixtures and lenses shall be fire resistant and shall not drip flaming material onto seats or interior trim if burned. The fixtures shall be sealed to prevent accumulation of dust and insects, but shall be easily openable on hinges for cleaning and service. The lenses shall be retained in a closed position and, if threaded fasteners are used, they must be captive in the lens with cross recessed type heads.

TS 71.11 Driver Area

The driver's area shall have a light to provide general illumination and it shall illuminate the half of the steering wheel nearest the driver to a level of 10 to 15 foot candles. This light shall be controlled by a switch that is convenient to the driver. Power for this light must be turned off when the master switch is in the "off" position.

TS 71.12 Seating Areas

The interior lighting system shall provide a minimum 15 foot-candle illumination on a 1 sq ft plane at an angle of 45 degrees from horizontal, centered 33 in. above the floor and 24 in. in front of the seat back at each seat position. Allowable average light level for the rear bench seats shall be 7 foot-candles.

TS 71.13 Vestibules/Doors

Floor surface in the aisles shall be a minimum of 10 foot-candles, and the vestibule area a minimum of 4 foot-candles with the front doors open and a minimum of 2 foot-candles with the front doors closed. The front entrance area and curb lights shall illuminate when the front door is open and master run switch is in the “lights” positions. Rear exit area and curb lights shall illuminate when the rear door is unlocked.

TS 71.14 Step Lighting

LED step lighting for the intermediate steps between lower and upper floor levels shall be a minimum of 4 foot-candles and shall illuminate in all engine run positions. The step lighting shall be water proof, low-profile to minimize tripping and snagging hazards for passengers, and shall be shielded as necessary to protect passengers’ eyes from glare.

TS 71.15 Ramp Lighting

LED Exterior and interior ramp lighting shall comply with CFR Part 49, Sections 19.29 and 19.31.

TS 71.16 Farebox Lighting

An LED light fixture shall be mounted in the ceiling above the farebox location. The fixture shall be capable of projecting a concentrated beam of light on the farebox. This light will automatically come on whenever the front doors are opened and the run switch is in the “night run” or “night park” position.

TS 72. Fare Collection

The electronic farebox shall be furnished by DTPW.

All necessary hardware and electrical wires shall be included by the Contractor to ensure that the installation is complete and operational. DTPW approval is required for the installation of hardware and electrical wires prior to production.

Fare Box Location

Contractor shall provide unencumbered space to accommodate, the Cubic Western GFI Odyssey farebox. This space shall be as forward as practicable so that the installed device shall not restrict traffic in the passenger area especially wheelchairs or mobility aids. This space shall not restrict access to the driver's area and/or operation of driver controls. It shall permit easy removal of the cash box from the farebox. The DTPW will provide a farebox base for the mounting of the farebox. The Contractor shall mount farebox base securely. The specific location of the farebox mounting shall require the approval of DTPW.

Farebox Wiring

DTPW will provide a farebox floor mounting plate with terminal strip (see graphic below for Odyssey Farebox Base). Contractor shall provide a 12 volt-DC constant power supply with circuit breaker protection (amps TBD), and wiring to accommodate the alarm function of the farebox. Power shall be provided from the output of the Wilmore 24VDC-13.6VDC converter. Power shall be available with the master run switch in any position including off. The farebox power wiring must be a multi stranded, two conductor, sheathed, red/black pair, 14 gauge wires.

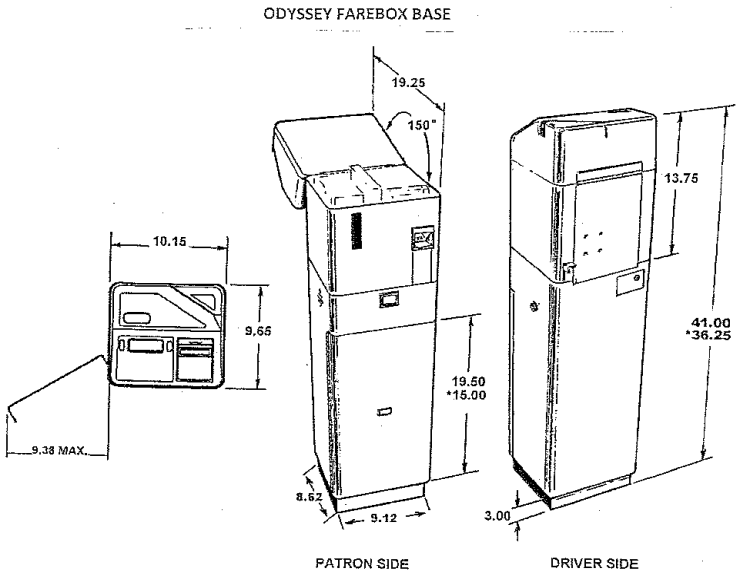


Figure 13-4: Farebox Dimensions

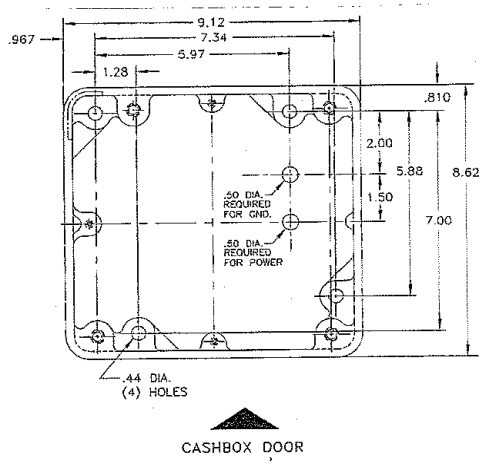
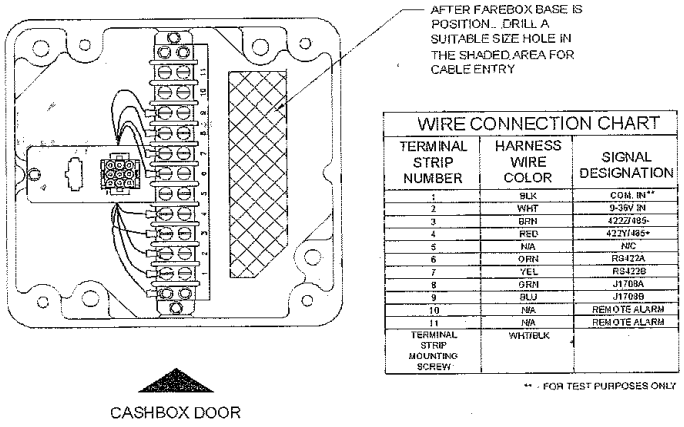


Figure 13-5: Hole positions on Farebox mounting plate



WIRE CONNECTION CHART

TERMINAL STRIP NUMBER	HARNESS WIRE COLOR	SIGNAL DESIGNATION
1	BLK	COM. IN**
2	WHT	9-36V IN
3	BRN	422Z/485-
4	RED	422Y/485+
5	N/A	NIC
6	ORN	RS422A
7	YEL	RS422B
8	GRN	J1708A
9	BLU	J1708B
10	N/A	REMOTE ALARM
11	N/A	REMOTE ALARM
TERMINAL STRIP MOUNTING SCREW	WHT/BLK	

** - FOR TEST PURPOSES ONLY

Figure 13-2: Farebox power and connectors

The Contractor shall provide wiring to accommodate the alarm function of the farebox. A 3 pair (6 conductors) color coded cable of 22 gauge stranded wire shall be installed from the farebox alarm output point to the Bus Alarm Termination Block. This cable is not available through Cubic Western. No splices are permitted in power and alarm cables. Farebox wiring (including alarm wiring) must be approved by DTPW prior to production.

TS 73. Interior Access Panels and Doors

Panels shall be color coordinated, vandal-resistant, able to withstand or repel repeated vandalism from marking pens and similar writing instruments, and shall not be damaged by repeated applications of commonly-used graffiti-removal chemicals. Access doors shall be hinged with gas props or over-center springs, where practical, to hold the doors out of the mechanic's way. Panels shall prevent entry of mechanism lubricant into the bus interior. All fasteners that retain access panels shall be captive in the cover.

Access doors shall be secured with locks. The locks shall be standardized so that only one tool is required to open access doors on the bus.

TS 73.1 Floor Panels

Access openings in the floor shall be sealed to prevent entry of fumes and water into the bus interior. Flooring material at or around access openings shall be flush with the floor and shall be edge-bound with stainless steel or another material that is acceptable to the Agency to prevent the edges from coming loose. Access openings shall be asymmetrical so that reinstalled flooring shall be properly aligned. Fasteners shall tighten flush with the floor.

Access openings in the floor shall be sealed to prevent entry of fumes and water into the bus interior.

The number of special fastener tools required for panel and access door fasteners shall be minimized.

PASSENGER ACCOMMODATIONS

TS 74. Passenger Seating

TS 74.1 Arrangements and Seat Style

The seating arrangement in the bus shall be such that seating capacity is maximized. Passenger seats shall be arranged in a transverse, forward facing configuration, except that aisle facing flip-up seats shall be provided at the wheelchair securement areas. Aisle facing seats may be allowed at wheel housings if needed for passenger access and comfort. Stainless steel barriers or modesty panels shall be provided in front of the first forward facing seats on both sides of the bus. If a bi-level floor is used, barriers or modesty panels shall be provided at the elevation change in front of the upper level seats. Weather shields of clear ½" polycarbonate shall be installed forward of the rear exit door above the seat back. The clear weather shield shall be covered on both sides with a removable clear scratch guard, 3M Scotchgard Multi-Layer Protective Film -1004MSor approved equal. The aisle between the seats shall be no less than 20 inches wide at seated passenger hip height.

Rear seat platform (rear settee) shall be hinged to gain access to engine compartment.

All seats shall have similar dimensions, materials, and construction characteristics. Inserts and back panels shall be individual and fully interchangeable between transverse and longitudinal seats.

A detailed seat layout with alternatives should be submitted to DTPW for review and approval with Requests for Approved Equal submittals.

TS 74.2 Rearward Facing Seats

Rearward facing seats are not allowed.

TS 74.3 Non-Padded Inserts

The passenger seats shall be equipped with non-padded, non-upholstered inserts throughout the bus.

TS 74.4 Drain Hole in Seats

Provision, such as a small hole, to allow drainage shall be incorporated into seat insert. (drain through hole – ¼ in. through hole, bottom seat only, one per seat)

TS 74.5 Hip-to-Knee Room

Hip-to-knee room measured from the center of the seating position, from the front of one seat back horizontally across the highest part of the seat to vertical surface immediately in front, shall be no less than 28 inches where practicable. In order to maximize seating capacity, minor variations in hip-to knee room may be allowed in limited areas with DTPW approval, but shall not be less than 26.5 inches.

TS 74.6 Foot Room

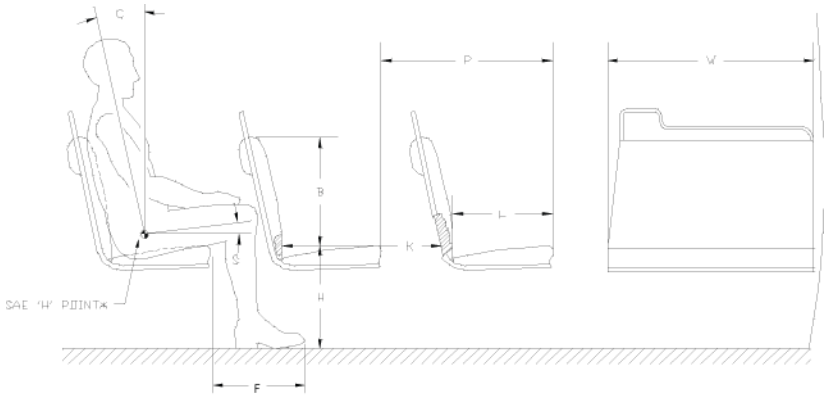
Foot room, measured at the floor forward from a point vertically below the front of the seat cushion, shall be no less than 14 in. Seats immediately behind the wheel housings and modesty panels may have foot room reduced provided the wheelhouse is shaped so that it may be used as a footrest or the design of modesty panel effectively allows for foot room.

TS 74.7 Aisles

The aisle between the seats shall be no less than 20 in. wide at seated passenger hip height. Seat backs shall be shaped to increase this dimension to no less than 24 in. at 32 in. above the floor (standing passenger hip height).

TS 74.8 Dimensions

Seating Dimensions and Standard Configuration



Seat dimensions for the various seating arrangements shall have the dimensions as follows (refer to Figure above):

- The width, W, of the two-passenger transverse seat shall be a minimum 35 in.

- The length, L, shall be 17 in., ±1 in.
- The seat back height, B, shall be a minimum of 15 in.
- The seat height, H, shall be 17 in., ± 1 in. For the rear lounge (or settee) and longitudinal seats, and seats located above raised areas for storage of under-floor components, a cushion height of up to 18 in., ±2 in., will be allowed. This shall also be allowed for limited transverse seats, but only with the expressed approval of the Agency.
- Foot room = F.
- The seat cushion slope, S, shall be between 5 and 11 degrees.
- The seat back slope, C, shall be between 8 and 17 degrees.
- Hip to knee room = K.
- The pitch, P, is shown as reference only.

TS 74.9 Structure and Design

The passenger seat frame and its supporting structure shall be constructed and mounted so that space under the seat is maximized and is completely free of obstructions to facilitate cleaning.

Passenger seats shall be of a cantilever design with vandal resistant removable inserts with stainless steel grab rails and un-upholstered inserts. The seats design should be submitted to DTPW for review and approval with the proposal.

The general design of the seat shall offer superior product and functional values with features providing optimum comfort and safety for the passenger. The design of the seat shall be based on requirements defined to obtain a structure which will conform to the strength, performance, and dynamic tests specified in the Testing and Strength Requirements Section. The passenger seat, frame, and its supporting structure shall be constructed and mounted so that space under the seat is maximized to increase wheelchair maneuvering room and is completely free of obstructions to facilitate cleaning. The lowest part of the seat assembly that is within 12 inches of the aisle shall be at least 10 inches above the floor. The underside of the seat and the sidewall shall be configured to prevent debris accumulation.

The two-passenger transverse seats shall be fixed, forward-facing cantilever type, designed, engineered and installed in accordance with layout drawings. The use of pedestals shall be limited to areas which cannot be supported by the side wall of the bus. Longitudinal, flip-up, and rear settee seats shall conform to the same general design and width as the two-passenger transverse seats. Longitudinal and rear settee backs shall be individual to correspond in configuration to transverse seat backs and are to be mounted on a common frame. All visible steel (cantilever frame and pedestals if applicable) and mounting hardware shall be stainless steel. No wood shall be used in the seats. All materials used in the seat assembly shall meet the flammability requirements of Federal Motor Vehicle Safety Standard No. 302.

Seat installation procedures and required torque values shall be provided to DTPW prior to production. Seat mounting fasteners shall be marked with torque paste after being properly torqued.

The seatback of each transverse seat shall have an energy absorbing grab rail or handhold. The handhold shall extend above the seat back near the aisle so that standees shall have a convenient vertical assist, no less than 4 inches long, that may be grasped with the full hand. This handhold shall not cause a standee using this assist to interfere with a seated 50th-percentile male passenger. The handhold shall also be usable by a 5th-percentile female, as well as by larger passengers, to assist with seat access/egress for either transverse seating position. The seat back handhold may be deleted from seats that do not have another transverse seat directly behind and where vertical assist is provided. Seat back handholds shall not be included in the design of longitudinal seats. The handhold shall not be a safety hazard during severe decelerations. The handhold shall be readily replaceable but attached securely to provide adequate and firm support. The overall design of the handhold shall be aesthetically pleasing and shall enhance the general appearance of the seat.

Armrests shall be included on the ends of each set of longitudinal seats except on the forward end of a seat that is immediately to the rear of a transverse seat, a modesty panel, a wheelchair barrier, or the operator's barrier, when these fixtures perform the function of restraining passengers from sliding forward off the seat. Armrests are not required on longitudinal seats located in the wheelchair parking area that fold up when the armrest on the adjacent fixed longitudinal seat is within 1-1/2 to 3-1/2 inches of the end of the seat cushion. Armrests shall not be included in the design of transverse seats. Provide tubular stainless steel armrests on the rear ends of any longitudinal seats immediately in front of the rear cross-seats. Armrests shall be located from 7 to 9 inches above the seat cushion surface and shall be free from sharp protrusions that form a safety hazard.

Panels shall be stainless steel, vandal-resistant, able to withstand or repel repeated vandalism from marking pens and similar writing instruments, and shall not be damaged by repeated applications of commonly-used graffiti-removal chemicals

The back panel shall be made of stainless steel. The back panel shall cover the rear of the seat back frame, and shall be free of sharp corners and protrusions. Back panel may be separate or integral with seat shell. The rear areas shall be recessed for increased passenger knee clearance.

Technical Data

The contractor should submit, at the time of Requests for Approved Equals, Certified Test Reports as evidence of compliance with the specifications and test requirements contained herein. The data shall substantiate the performance, reliability, and compliance with the safety performance established by the Transportation industry as a required level of excellence in seating. The test reports shall contain a record of the Static Load Tests, the Performance Tests, and Dynamic Tests. The reports must show test diagrams, photos of the tests, and load results on representative seats completely assembled and fastened to a fixture simulating the vehicle attachment. The test data for each test shall describe the test procedure and test equipment, the resultant deflection, the permanent deformation, and statement of inspection and compliance with specification requirements. The analysis shall indicate values relating to energy absorption and moderation of the magnitude of energy to the passengers. The analysis shall also substantiate the seat structure crash-worthiness relating to deformation characteristics and the strength required to prevent disintegration.

Testing and Strength Requirements

All testing shall be conducted on a representative transverse seat using a simulated bus floor, cantilever mounting device, and pedestal mounting device to correlate the results with conditions expected in normal usage of the seat.

Static Load Tests

Seat

The seat assembly shall withstand static vertical forces of 500 pounds applied to the top of the seat cushion in each seating position with less than 1/4-inch permanent deformation in the seat or its mountings.

Seat Back

The seat assembly shall withstand static horizontal forces of 500 pounds, forward and rearward, evenly distributed along the top of the seat back with less than 1/4-inch permanent deformation in the seat or its mountings.

Handhold and Armrest

Seat back handhold and armrests shall withstand static horizontal (forward and rearward) and vertical (downward) forces of 250 pounds applied anywhere along their length with less than 1/4-inch permanent deformation.

Performance Test

Drop Impact Test

Seats at both the aisle and window seating positions shall withstand 4,000 vertical drops of a 40-pound sandbag without visible deterioration. The sandbag shall be dropped 1,000 times each from heights of 6, 8, 10, and 12 inches.

Swinging Impact Test

The seat backs at the aisle position and at the window position shall withstand repeated impacts of two 40-pound sandbags without visible deterioration. One sandbag shall strike the front 40,000 times and the other sandbag shall strike the rear 40,000 times. Each sandbag shall be suspended on a 36-inch pendulum and shall strike the seat back 10,000 times each from distances of 6, 8, 10, and 12 inches.

Handhold and Armrest Impact Test

Seat back handhold and armrests shall withstand 25,000 impacts in each direction of a horizontal force of 125 pounds with less than 1/4-inch permanent deformation and without visible deterioration.

Dynamic Tests

Knee Injury Protection

All transverse objects, including seat backs, modesty panels, and longitudinal seats in front of forward facing seats, shall not impart a compressive load in excess of 1,000 pounds onto the femur of passengers ranging in size from a 5th-percentile female of a 95th-percentile male during a 10g deceleration of the bus. This deceleration shall peak at .05 ±.015 seconds from initiation.

Occupant and Frontal Crash Protection

Permanent deformation of the seat resulting from two 95th-percentile males striking the seat back during this 10g deceleration shall not exceed 2 inches, measured at the aisle side of the seat frame at height H. Seat back should not deflect more than 14 inches, measured at the top of the seat back, in a controlled manner to minimize passenger injury. Structural failure of any part of the seat or sidewall shall not introduce a laceration hazard.

Head Injury Protection

The upper rear portion of the seat back and the seat back handhold immediately forward of transverse seats shall be constructed of energy absorbing materials. During a 10g deceleration of the bus, the HIC number (as defined by SAE Standard J211a) shall not exceed 400 for passengers ranging in size from a 6 year old child through a 95th percentile male.

Specification for High Impact Thermoplastic

Physical Property	Specification	Test Method
Tensile Yield Strength	4400 – 6000 PSI	ASTM D-638

Flexural Modulus	220,000 – 333,000 PSI	ASTM D-790
Flexural Yield Strength	6200 – 97000 PSI	ASTM D-790
Izod Impact Resistance	3 – 8 ft/lb/ 1/8Notch	ASTM D-256
Specific Gravity	1.04 – 1.40	ASTM D-792
Hardness (Rockwell)	R 81 – 105	ASTM D-785

TS 74.10 Construction and Materials

Selected materials shall minimize damage from vandalism and shall reduce cleaning time. The seats shall be attached to the frame with tamper-resistant fasteners. Coloring shall be consistent throughout the seat material, with no visually exposed portion painted. Any exposed metal touching the sides or the floor of the bus shall be stainless steel. The seat and inserts shall be contoured for individuality, lateral support and maximum comfort and shall fit the framework to reduce exposed edges.

The minimum radius of any part of the seat back, handhold or modesty panel in the head or chest impact zone shall be a nominal ¼-in. The seat back and seat back handhold immediately forward of transverse seats shall provide passenger protection and, in a severe crash, allow the passenger to deform the seating materials in the impact areas. Complete seat assemblies shall be interchangeable to the extent practicable.

DTPW may request a production 2-passenger transverse seat from any prospective seat supplier, to be delivered to DTPW during the Approved Equals process prior to technical proposal evaluation. Seat will then be dismantled to determine life cycle costs and evaluate necessary repair techniques. Upon request, DTPW shall reassemble and return to the supplier.

Proposers are requested to propose an interior color scheme that is practical and coordinates with the proposed exterior paint scheme.

DTPW will make final selection of seat insert colors prior to production.

TS 75. Passenger Assists

Passenger assists in the form of full closed grip vertical stanchions or handholds shall be provided for the safety of standees and for entering and exiting of passengers. Passenger assists shall be convenient in location, shape and size for both the 95th percentile male and the 5th percentile female standee. Starting from the entrance door and moving anywhere in the bus a vertical assist shall be provided either as the vertical portion of seat back assist or as a separate item so that a 5th percentile female passenger may easily move from one assist to another using one hand or the other without losing support. Excluding those mounted on the seats and doors, the assists shall be between 1-1/4 and 1-1/2 inches in diameter with radii no less than 1/4 inch and shall permit a full closed hand grip with no less than 1-1/2 inches of knuckle clearance around the assist. A crash resulting in a one-foot intrusion shall not produce sharp edges, loose rails or other potentially dangerous conditions associated with a lack of structural integrity of the supporting brackets. Assists shall be securely clamped to prevent passengers from moving or twisting the assists. All areas of the passenger assists that are handled by passengers including functional components used as passenger assists, shall be stainless steel with fittings and fasteners to match the tubing. Stanchions at center aisle stairs, which shall be high contrast yellow powder coated or nylon coated.

Assists shall withstand a force of 300 pounds applied over a 12 inch lineal dimension in any direction normal to the assist without permanent visible deformation. Brackets, clamps, screw heads and other fasteners used on the passenger assists shall be flush with the grabrails and stanchions located throughout the bus. The number, mounting, location and arrangement of all passenger assists shall require concurrence of the DTPW.

TS 75.1 Assists

Excluding those mounted on the seats and doors, the assists shall have a cross-sectional diameter between 1¼ and 1½ in. or shall provide an equivalent gripping surface with no corner radii less than ¼ in. All passenger assists shall permit a full hand grip with no less than 1½ in. of knuckle clearance around the assist. Passenger assists shall be designed to minimize catching or snagging of clothes or personal items and shall be capable of passing the NHTSA Drawstring Test.

Any joints in the assist structure shall be underneath supporting brackets and securely clamped to prevent passengers from moving or twisting the assists. Seat handholds may be of the same construction and finish as the seat frame. Door mounted passenger assists shall be of anodized aluminum, stainless steel or powder-coated metal. Connecting tees and angles may be powder-coated metal castings. Assists shall withstand a force of 300 lbs applied over a 12-in. lineal dimension in any direction normal to the assist without permanent visible deformation. All passenger assist components, including brackets, clamps, screw heads and other fasteners used on the passenger assists shall be designed to eliminate pinching, snagging and cutting hazards and shall be free from burrs or rough edges.

TS 75.2 Front Doorway

Front doors, or the entry area, shall be fitted with ADA-compliant assists. Assists shall be as far outward as practicable, but shall be located no farther inboard than 6 in. from the outside edge of the entrance step and shall be easily grasped by a 5th-percentile female boarding from street level. Door assists shall be functionally continuous with the horizontal front passenger assist and the vertical assist and the assists on the wheel housing or on the front modesty panel.

TS 75.3 Vestibule

The aisle side of the driver's barrier and the modesty panels or wheel housings shall be fitted with vertical passenger assists that are functionally continuous with the overhead assist and that extend to within 36 inches of the floor. These assists shall have sufficient clearance from the barrier to prevent inadvertent wedging of a passenger's arm. A horizontal passenger assist of stainless steel metal tubing shall be located across the front of the bus, around the farebox, and shall prevent passengers from sustaining injuries on the farebox or windshield in the event of a sudden deceleration. Without restricting the vestibule space, the assist shall provide support for a boarding passenger from the front door through the fare collection procedure. Passengers shall be able to lean against the assist for security while paying fares. The assist shall be no less than 36 inches above the floor or the average step tread surface. The assist at the front of the bus shall be arranged to permit a 5th percentile female passenger to easily reach from the door assist, to the front assist, to vertical assists on the driver's barrier, front modesty panel, or wheel house. The passenger assist around the farebox shall not interfere with opening of farebox access doors.

Unless passenger seating is provided on top of wheel housing, passenger assists shall be mounted across and around the exposed sides of the wheel housings which shall be designed to prevent passengers from sitting on wheel housings and effectively retain items, such as bags and luggage, placed on top of wheel housing.

Except for seats that flip up to accommodate wheelchair securement, assists shall extend from near the leading edge of longitudinal seats and shall be functionally continuous with the overhead assist. Assists shall be staggered across the aisle from each other where practicable.

A 1/8” diameter hole, 42” above floor level, shall be provided in the vertical stanchion adjacent to the entrance door to be used a maximum height indicator for children’s fares. The hole shall be oriented to face the driver.

TS 75.4 Rear Doorway(s)

Vertical assists that are functionally continuous with the overhead assist shall be provided at the aisle side of the transverse seat immediately forward of the rear door and on the aisle side of the rear door modesty panel(s). Passenger assists shall be provided on modesty panels that are functionally continuous with the rear door assists. Rear doors, or the exit area, shall be fitted with assists having a cross-sectional diameter between 1¼ and 1½ in. or providing an equivalent gripping surface with no corner radii less than ¼ in., and shall provide at least 1½ in. of knuckle clearance between the assists and their mounting. The assists shall be designed to permit a 5th-percentile female to easily move from one assist to another during the entire exiting process. The assists shall be located no farther inboard than 6 in. from the outside edge of the rear doorway step.

Passenger assists will be provided to aid in the transition between the front and rear sections of the bus.

TS 75.5 Overhead

Except forward of the standee line and at the rear door locations a continuous, full closed grip, overhead assist shall be provided. This assist shall be convenient to standees anywhere in the bus and shall be located over the center of the aisle seating position of the transverse seats on both sides of the aisle. The assist shall be no less than 72 inches above the floor. No more than five percent of the full closed grip feature shall be lost due to assist supports. Four nylon web straphangers shall be provided on the overhead assists over the wheelchair securement areas on both sides of the aisle.

Location of the straps shall be submitted to DTPW for review and approval prior to production.

Overhead assists shall simultaneously support 150 lbs on any 12-in. length. No more than 5 percent of the full grip feature shall be lost due to assist supports.

TS 75.6 Longitudinal Seat Assists

Longitudinal seats shall have vertical assists located between every other designated seating position, except for seats that fold/flip up to accommodate wheelchair securement. Assists shall extend from near the leading edge of the seat and shall be functionally continuous with the overhead assist. Assists shall be staggered across the aisle from each other where practicable and shall be no more than 52 in. apart or functionally continuous for a 5th percentile female passenger.

TS 75.7 Wheel Housing Barriers/Assists

Unless passenger seating is provided on top of wheel housing, passenger assists shall be mounted around the exposed sides of the wheel housings (and propulsion compartments if applicable), which shall also be designed to prevent passengers from sitting on wheel housings. Such passenger assists shall also effectively retain items, such as bags and luggage, placed on top of wheel housing.

TS 76. Passenger Doors

Two (2) doors shall be provided in the bus for passenger ingress and egress. The front door shall be located on the curbside in the front of the bus, such that the driver is able to collect and monitor the collection of fares. The doors and doorways shall comply with the most recent revision of ADA requirements.

If air-powered, the door system shall operate per specification at air pressures between 90 and 130 psi.

Materials and Construction

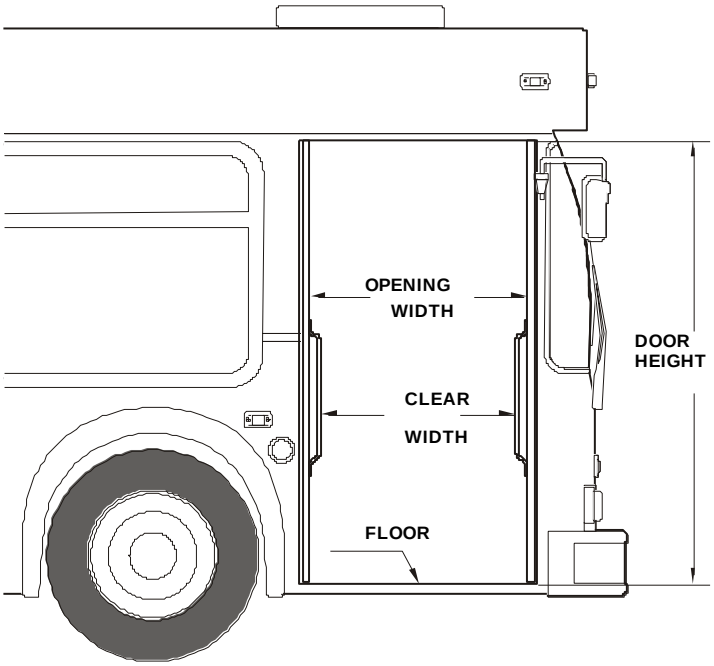
Structure of the doors, their attachments, inside and outside trim panels, and any mechanism exposed to the elements, shall be durable and corrosion-resistant. Door panel construction shall be of aluminum, stainless steel, or reinforced non-metallic composite materials. Fasteners shall be stainless steel. Fasteners shall be designed to permit multiple replacements of parts. Sheet metal screws shall not be used to fasten objects to the doors. Stainless steel passenger assist handles shall be installed on the door panels. The doors, when

fully opened, shall provide a firm support and shall not be damaged if used as an assist by passengers during ingress or egress. Doors shall be non-rattling in closed position. Door edges shall be sealed to prevent infiltration of exterior moisture, noise, dirt and air elements from entering the passenger compartment, to the maximum extent possible based on door types.

The closing edge of each door panel shall have no less than 2 in. of soft weather stripping. The doors, when closed, shall be effectively sealed, and the hard surfaces of the doors shall be at least 4 in. apart. The combined weather seal and window glazing elements of the front door shall not exceed 10 degrees of binocular obstruction of the driver's view through the closed door.

TS 76.1 Dimensions

FIGURE 8
Transit Bus Minimum Door Opening



Front door clear width shall be no less than thirty-two (32) inches and rear door clear width shall be no less than thirty (30) inches with the doors fully opened. Clear width shall be measured between door-mounted passenger assists. The door opening height shall be no less than seventy-six (76) inches. Projections on doors and in entry area shall not form a hazard to passengers.

TS 76.2 Door Glazing

The upper section and the lower section of the front door shall be glazed for no less than one half the respective door opening area of each section. The edge of a 6 inch high curb shall be visible to the seated driver through the closed door when the bus is more than 12 inches from the curb.

The upper section of the rear door shall be glazed for no less than one half the respective door opening area of each section. Bottom half of door panel shall be metal and not have a window.

The front and rear door panel glazing material shall be a nominal ¼ inch laminated safety glass conforming to the requirements of ANSI Z26.1 Test Grouping 2 and the Recommended Practices defined in SAE J673.

TS 76.3 Door Projection

Exterior

The exterior projection of the front doors beyond the side of the bus shall be minimized and shall not block the line of sight to the rear curbside of the bus via the curbside mirror when the doors are fully open. The exterior projection of both doors shall be minimized and shall not exceed 13 inches during the opening or closing cycles or when doors are fully opened. Projection inside the bus shall not exceed 21 inches. The closing edge of each door panel shall have no less than 2 inches of soft weather stripping. The hard surfaces of the doors shall be at least four (4) inches apart. The door, when closed, shall be effectively sealed to prevent the entrance or exit of air and water. The front panel edge shall lap over rear panel edge by a minimum of one-half (1/2) inch.

Interior

Projection inside the bus shall not cause an obstruction of the rear door mirror or cause a hazard for standees.

TS 76.4 Door Height Above Pavement

It shall be possible to open and close either passenger door when the bus loaded to gross vehicle weight rating is not knelt and parked with the tires touching an 8-in.-high curb on a street sloping toward the curb so that the street side wheels are 5 in. higher than the right side wheels.

TS 76.5 Closing Force

The closing force shall be limited to avoid injury to a passenger caught in a closing door Closing door edge speed shall not exceed 19 inches per second. All doors shall be equipped with sensitive edges, including the rear doors with the Vapor “Class” system, such that if an obstruction is struck by a closing door edge, the doors will stop and/or reverse direction prior to imparting a 10-pound force on 1 square inch of that obstruction. It shall be possible to withdraw a 1-1/2 inch diameter cylinder from between the center edges of a closed and locked door with an outward force not greater than 35 pounds.

TS 76.6 Actuators

Door actuators shall be Vapor or approved equal, using pneumatic single differential door engines or electric door motors, adjustable so that the door opening and closing speeds can be independently adjusted from 2 seconds to 4 seconds. Pneumatic door engine control valves shall be 3-way poppet valves. Actuators and the complex door mechanism shall be concealed from passengers, but shall be easily accessible for servicing. Actuators shall exhaust air below floor level. Actuators shall provide smooth even door operation and prevent door slamming at the end of its travel.

The rear doors must close in two (2) seconds from the full open position when the bus is on an 8-degree slope toward the curb (right side).

The rear doors shall be passenger-controlled. The vehicle operator shall unlock and enable the opening mechanism, which shall be annunciated by illumination of a green light near the door. After enabling and unlocking, the doors shall be opened by a powered mechanism actuated by passenger activation of a contactless sensing system.

A switch located within reach of the seated operator shall, when actuated, restore rear door function to complete operator control, as described in the “Default.”.

Locked doors shall require a force of more than 300 lbs to open manually. When the locked doors are manually forced to open, damage shall be limited to the bending of minor door linkage with no resulting damage to the doors, actuators or complex mechanism.

TS 76.7 Door Interlocks

To preclude movement of the bus with the front or rear door open, when the door control is activated an accelerator interlock shall remove throttle control returning the engine to idle speed and a brake interlock shall engage the brakes. The interlocks shall remain on until the door switch is deactivated and the doors are in the fully closed position and a service brake application is made.

Air pressure shall be relieved by means of a quick release air valve to prevent lag in releasing brakes when doors are closed.

The braking effort shall be adjusted to limit deceleration level. The braking effort shall be adjustable with hand tools only. The adjustment device shall be enclosed in tamper proof housing if located inside the bus.

The doors must be wired to a speed sensor so that the interlock cannot be activated and the doors cannot be opened at a speed above 4 mph.

With the master run switch in the off position and the door open, the door, the interlock, and the stop lights must not be energized.

TS 76.8 Emergency Operation

In the event of an emergency, it shall be possible to open the door manually from inside the bus using a force of not more than 25 pounds after actuating an unlocking device at the door. The unlocking device shall be clearly marked as an emergency-only device and shall require two distinct actions to actuate. Trilingual instructions, approved by DTPW, shall be installed at the device. When the door emergency device is actuated, the brake and accelerator interlocks shall be activated, thereby removing throttle control and stopping the bus. The brakes shall not be applied until the bus speed falls below 4 MPH. Doors that are required to be classified as “Emergency Exits” shall meet the requirements of FMVSS 217.

A handle or assist shall be provided on the door panel at a convenient location to assist manual operation of the door after the emergency handle has been pulled.

TS 76.9 Door Control

Front and rear doors shall be controlled by the operator from a door control switch located on the driver's left hand side. The handle shall be removable and can be utilized for use in opening access panels.

The opening and closing of the front door shall be activated directly by the operator by means of the door control switch.

The rear door shall be equipped with a Vapor CLASS acoustic sensor system or approved equal to allow passengers to activate the opening of the door after the operator, by means of the door control switch, has unlocked it. A green L.E.D. light above the door will indicate that the door is unlocked. The door shall close automatically when the door area is clear of passengers.

A switch located convenient to the driver shall allow the driver to select whether rear door opening is activated by the passenger using the Vapor CLASS system or opening and closing is activated directly by the driver using the door control switch.

A control or valve in the driver's compartment shall dump the air from the door mechanism to provide manual operation of the doors with the bus shut down. When the power is cut to the door, either by this control or by shutting the bus off through the run switch, the doors shall not slam closed.

Front and rear doors shall have independent electrical circuits so a failure or short in one door circuit will not affect operation of the other doors. Provide separate door master power switches to cut off power to each

door and deactivate its interlock circuit. Door master power switches shall be permanently labeled and located in the door motor compartment or other approved location. The door master power switches shall be accessible without the use of tools.

TS 76.10 Door Controller

Five-Position Driver's Door Controller

The control device shall be protected from moisture. Mounting and location of the door control device handle shall be designed so that it is within comfortable, easy arm's reach of the seated driver. The door control device handle shall be free from interference by other equipment and have adequate clearance so as not to create a pinching hazard.

Position of the door control handle shall result in the following operation of the front and rear doors:

- **Center position:** Front door closed, rear door(s) closed or set to lock.
- **First position forward:** Front door open, rear door(s) closed or set to lock.
- **Second position forward:** Front door open, rear door(s) open or set to open.
- **First position back:** Front door closed, rear door(s) open or set to open.
- **Second position back:** Front door open, rear door(s) open or set to open.

TS 76.11 Door Open/Close

Operator-Controlled Front and Passenger-Controlled Rear Doors with Provision for Driver Override

Operation of, and power to, the front passenger doors shall be completely controlled by the operator. Power to rear doors shall be controlled by operator. After enabling, the rear doors shall be opened by the passenger. A switch shall be provided to enable the driver to obtain full control of the rear doors.

A control or valve in the operator's compartment shall shut off the power to, and/or dump the power from, the front door mechanism to permit manual operation of the front door with the bus shut down. A master door switch, which is not within reach of the seated operator, when set in the "off" position shall close the rear/center doors, deactivate the door control system, release the interlocks, and permit only manual operation of the rear/center doors.

TS 77. Accessibility Provisions

Space and body structural provisions shall be provided at the front door of the bus to accommodate a wheelchair loading system.

TS 77.1 Loading Systems

A self-contained fold-out type wheelchair ramp system, compliant with requirements defined in most recent revision of 49 CFR Part 38, Subpart B, §38.23c, shall be provided. The ramp system shall be a Lift-U model LU-12 electrically powered or approved equal.

The ramp shall provide ingress and egress for a passenger in a wheelchair from a level street or curb. The wheelchair loading system shall be located at the front door. The ramp shall be of a simple hinged, flip-out type design. When the ramp is in the stored position no tripping hazards shall be presented and any resulting gaps shall be minimized. There shall be no obstructions, obstacles, edges, or gaps on the ramp or the adjacent floor surface, greater than ¼ inch in height or width, except for ramp side barriers specifically required by the A.D.A.

The loading platform shall be covered with a replaceable or renewable, nonskid material and shall be fitted with devices to prevent the wheelchair from rolling off the sides during loading or unloading. A passenger or attendant, standing on the ramp platform, shall be able to easily obtain support during the entire loading or unloading operation by grasping passenger assists provided for this purpose.

The controls shall be simple to operate and the ramp operation shall be under the control of the operator. The ramp shall be electrically controlled and operated without any hydraulic assist. The ramp controls shall be clearly marked and consist of spring-loaded momentary switches which when released by the operator, shall cause the ramp motion to stop in any position while deploying or stowing. The ramp shall not be capable of operation until the bus parking brake is on, the transmission is in neutral, and the doors are in the fully open position. When the doors are open the bus throttle and brake interlocks shall be activated. The bus shall be prevented from moving while the ramp is deployed by the throttle and brake interlock. The bus shall not be able to move until the ramp is fully stowed. In the event of a failure, the interlocks shall be released by setting the door master power switch in the "OFF" position. The ramp shall be inhibited from folding when a passenger is on the ramp. The bus shall be inhibited from kneeling with the ramp in the deployed position.

Submit proposed ramp system to DTPW for approval.

Warning lamps and audible alarms shall meet all Federal and State of Florida requirements. In addition, the bus hazard warning flashers shall activate when the ramp is deployed.

The wheelchair ramp shall conform to ADA standards and be legibly and permanently marked by the manufacturer or installer with the following information:

1. The manufacturer's name and address.
2. The month and year of manufacture.
3. A certificate that the wheelchair ramp securement devices, and their installation, conform to State of Florida requirements applicable to accessible buses.

The manufacturer must certify ramps to meet or exceed all A.D.A. and F.T.A. requirements, including D.O.T.-T-93-03. The ramp shall have a label indicating that it meets the requirements of the State of Florida.

One Ramp Handle (tool) per bus shall be provided for ramp manual deployment.

Spare Wheelchair Ramps

Pricing for Spare Wheelchair Ramps (Complete Assembly) shall be provided by the Contractor. DTPW shall have the option to purchase up to ten (10) Spare Wheelchair Ramps.

TS 77.2 Wheelchair Accommodations

Two forward-facing locations, as close to the wheelchair loading system as practical, shall provide parking space and securement system compliant with ADA requirements for a passenger in a wheelchair. Parking space shall be compliant with ADA requirements in 49 CFR Part 38, Subpart B. The wheelchair securement and occupant restraint system must be tested and conform to SAE J2249 and must meet the requirements of FMVSS 222 and the ADA. A documentation proving that the pilot bus or first production bus (if no pilot bus available) meets or exceed SAE J2249, FMVSS 222, and ADA requirements need to be provided by the bus manufacturer.

A 3-point securement system shall be provided. A convenient retractable belt storage system is to be incorporated in the overall securement system so that all belts are easily stored out of the way when not in use. An integral retractable lap/shoulder belt passenger restraint shall be provided for each of the two securement locations. Systems known to meet these requirements include, but are not limited to the Q'Straint Q'Pod and American Seating Reliant, systems.

TS 77.3 Interior Circulation

Maneuvering room inside the bus shall accommodate easy travel for a passenger in a wheelchair from the loading device and from the designated securement area. It shall be designed so that no portion of the

wheelchair protrudes into the aisle of the bus when parked in the designated parking space(s). When the positions are fully utilized, an aisle space of no less than 20 in. shall be maintained. As a guide, no width dimension should be less than 34 in. Areas requiring 90-degree turns of wheelchairs should have a clearance arc dimension no less than 45 in., and in the parking area where 180-degree turns are expected, space should be clear in a full 60-in.-diameter circle. A vertical clearance of 12 in. above the floor surface should be provided on the outside of turning areas for wheelchair footrest.

SIGNAGE AND COMMUNICATION

TS 78. Destination Signs

A destination sign system shall be furnished on the front, on the rear, and on the right side near the front door.

General

An electronic destination sign system shall be furnished and installed by the Contractor.

All necessary hardware, brackets and electrical wires shall be included by the Contractor to ensure that the installation is complete and operational.

A wiring schematic showing the proposed electrical hook up to the bus electrical system and vehicle area network must be supplied to DTPW prior to pre-production design review.

A list of the routes to be displayed will be supplied by DTPW for programming the memory of the computer and transfer unit.

The sign boxes shall inhibit entry of dust, water and insects during normal operation of cleaning with a cyclone cleaner. Easy access shall be provided to clean the inside of the destination sign windows and to remove or replace the sign mechanism.

The bus manufacturer shall comply with the destination sign manufacturer's recommended mounting configuration and installation procedures to assure optimum visibility of all the sign displays.

Description

The destination sign system shall be Twin Vision Smart Series III LED Display System (with Color LED front sign) or approved equal. The front sign shall be a Luminator Titan Gen 4 Spectrum LED or approved equal. The sign system will interconnect with the Clever Devices VLU which will furnish the sign system and the stop announcement system with destination and route information. The destination sign system’s driver's code panel shall be capable of providing destination and route information to the sign if the bus VLU or TCH fails.

Spare Destination Sign Sets

Spare Destination Sign Sets (Complete system) shall be provided by the Contractor and priced separately from the bus in the Price Proposal. DTPW shall have the option to purchase up to five (5) Spare Destination Sign Sets.

Programming Equipment

Programming equipment shall be provided at no additional cost to DTPW.

Documentation Requirements

All documentation should be submitted directly to DTPW, Field Engineering; 3300 N.W. 32 Avenue, Miami, FL 33142

Provide five (5) copies of parts and maintenance manuals.

The contractor should provide a list of all special or custom tools or instruments required to maintain or adjust any components within the system.

A complete bill-of Materials giving a unique part number, description, generic name and generic part number for each and every component shall be required. Every part of the destination sign system shall be identified and quantified, even down to a specific diode, capacitor or screw.

Diagrams and drawings shall identify each and every component in the Destination Sign System and call out each component with the unique part number.

Provide manuals in electronic format viewable in a WEB browser with HTML pages by Assemblies (drawings) in JPG with “hot links” to all the vendor parts per assembly (Bill of Materials) and a listing or table of each vendor part number with the associated HTML hot link.

The Contractor should provide a layout for every printed circuit board specially calling out each component, be it mechanical or electrical, and showing its exact location.

The Contractor should provide drawings showing the location of all the traces on the top and bottom of each printed circuit board.

Each type of maintenance manual shall contain but not be limited to: a description of operation; installation procedures; a complete parts identification diagram and list; trouble shooting procedures; inspection procedures; preventive maintenance procedures and program; wiring diagrams; electrical schematics with board and cable identification; and adjustment procedures.

TS 79. Passenger Information and Advertising

TS 79.1 Interior Displays

Provisions shall be made on the rear of the driver’s barrier or equipment box located on the wheel well for a frame to retain information such as routes and schedules.

Advertising media 11 in. high and 0.09 in. thick shall be retained near the juncture of the bus ceiling and sidewall. The retainers may be concave and shall support the media without adhesives. The media shall be illuminated by the interior light system.

Internal Dynamic Message Signs

Internal dynamic message signs shall display coordinating text for next stop and other audio announcements. The signs shall meet all ADA requirements for internal signage. The signs shall be a Light Emitting Diode (LED) type sign with 16 characters per line with bright yellow or amber LEDs. Signs shall be no larger than 27” x 2 1/8” x 4 1/8” (single line). The signs shall be programmable via the Clever Devices Central Recording Station . Messages shall be programmable to be streaming or by any of 3 single frame modes with automatic centering. Speed, delays, and looping shall be programmable. Busy/ready status shall be poll-able. Forced reset capability shall exist.

The internal LED display signs shall be used to display the words “Stop Requested” and shall be visible to passengers. This shall be illuminated when the passenger chime is activated and shall remain on until the front or rear door is opened. The internal LED display signs shall also be used to display “Lift Requested” when the passenger chime is activated provided there are separate outputs on the vehicle to designate different chimes for Stop Requested and Lift Requested.

The Internal Display Sign enclosures shall be aluminum with welded and sanded seams (see Note 1), black powder paint finish and yellow or amber acrylic fascia with matte finish for reduction of reflected glare. Signs shall be constructed to withstand the harsh environmental conditions found in transit applications.

Note: The enclosure may be a seamless aluminum extrusion with ends secured with tamper-resistant screws. All edges and corners shall be rounded and smooth.

TS 79.2 Exterior Displays

No exterior display provisions shall be provided.

TS 80. Passenger Stop Request/Exit Signal

Pull Cord Passenger Signal

A passenger “stop requested” signal system that complies with applicable ADA requirements defined in 49 CFR, Part 38.37 shall be provided. The system shall consist of a heavy-duty pull cable, chime and interior sign message. The pull cable shall be located the full length of the bus on the sidewalls at the level where the transom is located. If no transom window is required, the height of the pull cable shall approximate this transom level and shall be no greater than 63 in. as measured from the floor surface. It shall be easily accessible to all passengers, seated or standing. Pull cable(s) shall activate one or more solid state or magnetic proximity switches. At each wheelchair passenger position and at priority seating positions, additional provisions shall be included to allow a passenger in a mobility aid to easily activate the “stop requested” signal.

An auxiliary passenger “stop requested” signal shall be installed at the rear door to provide passengers standing in the rear door/exit area convenient means of activating the signal system. The signal shall be a heavy-duty push button type located in the rear door vicinity. Button shall be clearly identified as “passenger signal.”

A single “stop requested” chime shall sound when the system is first activated. A double chime shall sound anytime the system is activated from wheelchair passenger areas.

Exit signals located in the wheelchair passenger area shall be no higher than 4 feet above the floor. Instructions shall be provided to clearly indicate function and operation of these signals.

TS 81. Communications

TS 81.1 Camera Surveillance System

The CCTV Surveillance system shall consist of a MobileView 7000 Series Network Video Recorder (NVR), 12 cameras, minimum 2TB dual hard drive on-board video storage, and be capable of recording at up to 360 frames per second for all connected cameras or approved equal.

Regulated 13.6 volts DC power shall be provided for the DVR system by the output of the dedicated electronics systems power supply.

Tamperproof Torx screws shall be provided for all camera housings and access covers.

Loom for the facing forward camera wires located below the destination sign compartment near the top of the windshield shall be provided.

An impact sensor shall be provided.

A system status indication shall be provided on the dashboard through the I/O Controls multiplex (or approved equal) warning indicator LED display.

The forty-foot bus shall be equipped with 10 CCTV GE (Kalatel) cameras or approved equal as follows:

1. A low LUX camera mounted below the destination sign compartment near the top of the windshield, forward facing. The camera shall be a color camera with the capability to capture images in ambient lighting at night. If necessary, the camera may switch to black and white under very low lighting conditions. The field of view shall include the street in front of the bus, overhead traffic signal while stopped at an intersection and pedestrians on the sidewalk or at the curb approximately 8 feet in front of the bus. (4.0mm if practicable) The mounting shall be such as to prevent camera vibration, water intrusion, interference with the driver's visibility, and shall minimize color shift due to the tinting at the top of the windshield. A flexible rubber glare shield (hood) shall be provided on the camera. The housing window shall be glass or a material resistant to scratching, hazing, and cleaning chemicals. (Plastic dome housing is not acceptable.)

2. A color camera with infrared capability flush mounted in the panel above the driver facing the farebox and entry door. The camera shall be housed in an "angled down" box. The housing window shall be glass or a material resistant to scratching, hazing, and cleaning chemicals. The field of view shall wide angle (2.9mm if practicable) and include the driver, the farebox, and the entire entry door opening. The vestibule area shall be illuminated by an infrared emitter under low light conditions.

3. A color camera flush mounted in the panel above the front door facing the driver and farebox. The camera shall be housed in an "angled down" box. The housing window shall be glass or a material resistant to scratching, hazing, and cleaning chemicals. The field of view shall wide angle (2.9mm if practicable) and include the driver, driver compartment, and the farebox.

4. A color camera shall be flush mounted in the front destination sign compartment door facing rearward. The camera shall be housed in a shallow, waterproof box that will not interfere with the destination sign. The housing window shall be glass or a material resistant to scratching, hazing, and cleaning chemicals. The field of view shall include the entire length of the front bus body section interior and the articulated joint area (6.0mm if practicable).

5. A color camera shall be surface mounted on the centerline of the bus ceiling at the center of the bus. The camera shall be front facing. The housing window shall be glass or a material resistant to scratching, hazing, and cleaning chemicals. The field of view shall include the entire length of the front bus body section interior (4.0mm if practicable).

6. A color camera shall be surface mounted on the centerline of the bus ceiling at the center of the bus. The camera shall be rear facing. The housing window shall be glass or a material resistant to scratching, hazing, and cleaning chemicals. The field of view shall include the entire length of the front bus body section interior (4.0mm if practicable).

7. A color camera shall be surface mounted on the bus ceiling facing the rear door. The housing window shall be glass or a material resistant to scratching, hazing, and cleaning chemicals. The field of view shall wide angle (2.9mm if practicable) and include the entire rear door opening.

8. A color camera shall be surface mounted on the bus exterior over the driver's window near the roofline. The camera shall be facing rearward. The housing shall be waterproof and sealed from the exterior environment to prevent formation of condensation on the housing interior. The housing must be rugged to resist damage from tree limbs. The housing window shall be glass or a material resistant to scratching, hazing, and cleaning chemicals. The field of view shall include the entire length of the bus exterior and the traffic lane adjacent to the bus travel lane (6.0mm if practicable).

9. A color camera shall be surface mounted on the bus exterior over the front passenger door near the roofline. The camera shall be facing rearward. The housing shall be waterproof and sealed from the exterior environment to prevent formation of condensation on the housing interior. The housing must

be rugged to resist damage from tree limbs. The housing window shall be glass or a material resistant to scratching, hazing, and cleaning chemicals. The field of view shall include the entire length of the bus exterior and the traffic lane adjacent to the bus travel lane (6.0mm if practicable).

10. A color camera shall be surface mounted on the bus exterior at the rear above the engine compartment. The camera shall be facing rearward. The housing shall be waterproof and sealed from the exterior environment to prevent formation of condensation on the housing interior. The housing window shall be glass or a material resistant to scratching, hazing, and cleaning chemicals. The field of view shall include the rear bumper and the ground behind the bus (2.9mm if practicable).

Cameras shall have sufficiently high resolution to allow recognition of faces and to read roadside signs.

A complete description of the CCTV Surveillance system, including installation, shall be presented to DTPW for approval prior to production of the pilot bus or first production bus.

TS 81.2 Intelligent Vehicle System

General

The Contractor shall supply a bus with an Intelligent Vehicle System (IVS). This will provide accurate, reliable and timely bus performance and fault information and improve vehicle and passenger safety and security. IVS will be integrated with the onboard microprocessor controlled systems and with the Transit Agency Wireless and Ethernet LAN to create a fully intelligent vehicle that will increase vehicle performance, optimize fleet utilization, and increase operational efficiency.

The IVS is primarily constituted of bus onboard system and a depot system. The bus onboard system will have the main function to deliver the passenger friendly functionalities, interface to the vehicle operator, and collect the fault and performance data from all of the microprocessor based systems.

The depot system is required to download system updates and Transit Agency data, and collect fault and performance data uploaded from the buses through the wireless link (this system is not part of this procurement).

The bus builder shall supply the IVS system in accordance with the requirements outlined in this document. The bus builder shall develop a scope of supply, system integration and implementation.

The Bus Manufacturer shall be responsible for proving the installation of the IVS in the bus, the functional interfaces between this equipment and the bus, and to ensure that bus systems comply with the requirements of this document. The supply and proper functioning of all interfaces shall be provided in accordance with the requirements of this Specification.

IVS onboard System

The onboard system is the key element of the IVS system and will consist of the following components: Vehicle Logic Unit, Mounting Bracket, Bus Interface Harness, Internal Sign, Multi-Band Roof-Mount Antenna (used for Wireless LAN, Cellular Communication and GPS), Wireless LAN Antenna Cable and GPS Antenna Cable.

Each bus shall be provided with one Vehicle Logic Unit that will be wired for and capable of delivering the functions of the on board System. The main functions are listed below:

- Automatic Vehicle Annunciation
- External Sign System Control
- Mobile Data Terminal
- GPS and Dead Reckoning
- Automatic Passenger Counting

- Automatic Vehicle Monitoring
- Hard Brake and Last Stop Reporting

The bus builder is required to present the complete implementation of the IVS, its features and its provisions for technical compliance review.

Vehicle Logic Unit

General

The VLU (Vehicle Logic Unit) shall be an open-standards based PC controller installed on the bus. The VLU shall employ a vast array of connections and interfaces to all on-board systems via standard PC and Transit system communication standards. This shall allow for growth for future onboard ITS systems and many years of service.

The VLU system shall provide integration to bus systems via proven transit and PC communication standards with SAE J1708/J1939/J1587, SAE J1939/CAN, RS232, and RS485 with busy line, TTL, USB, Ethernet, TCP/IP, discrete inputs and outputs, odometer, spare I/O, audio inputs and outputs, and full IDE capability for PC-type devices.

The VLU shall use RS232, J1939 and J1708 to transmit information to the in-vehicle electronic display signs.

The VLU shall be capable of integrating with camera systems to support security setups such as CCTV via standard SAE Vehicle Area Network Interfaces such as J1939/J1708.

VLU system shall be capable of handling GPS data in all areas.

The VLU shall employ advanced location algorithms that utilize the GPS, gyroscopic heading, and odometer pulse to accurately report where the bus is along the route.

The VLU shall employ these advanced location algorithms to ensure precise ADA compliant announcements as well as ridership data collection.

The VLU system functionalities shall include but not be limited to AVA (Automatic Vehicle Annunciation), WLAN (Wireless Local Area Network), Vehicle Health Monitoring, Predictive Arrival, APC (Automatic Passenger Counter) and CAD/AVL (Computer Aided Dispatch/Automatic Vehicle Location).

The VLU shall employ integration that enables the necessary subsystems access to transmission of data through a single secure wireless LAN, which shall have the capability to integrate with a real time communications network.

In the event of an emergency causing a vehicle to lose communication links to the network VLU shall allow all on-board data to be retained locally on the bus.

The VLU shall be designed with forward looking, state-of-the-art technology and modularity.

The VLU shall be designed to support easy installation and replacement. This design shall allow the VLU to withstand the harsh elements of the public transportation environment. A strong body casing shall protect against falling dirt, rain, sleet, snow, wind blow dust, vibration, pressurized hose-directed water, corrosion, extreme temperature variations, and external formation of ice.

The VLU shall have a secure lock on the access door requiring a unique key to help protect the VLU from theft.

The VLU systems minimum functions, power management, environmental, and capability requirements are summarized below and in the VLU Compatibility Table.

The VLU, or approved equal, shall provide the hardware and software necessary to:

- Provide a single-point operator login for connected equipment
- Coordinate audio announcements and sign displays
- Accept data generated by CleverWorks or equivalent database management software applications

- Support Wireless Data Transfer for software, configuration, announcement data, and route data updates
- Off-load data and accept updates via USB data Key and/or WLAN
- Integrate with Clever Devices Transit Control Head (TCH)
- Integrate with internal LED signs for internal announcements
- Integrate with external sign systems for external signs and announcements
- Interface with J1587/J1939 engine controllers, transmissions, and other onboard devices
- Allow for future hardware and software expansion
- Supports all features and functions associated with the Clever Devices CleverCAD computer aided dispatch system

Hardware Characteristics

At a minimum, the VLU shall have the following hardware and characteristics:

- Overall size: 8.50” long, 8.38” wide, and 3.87” high.
- 4 audio outputs, 25W each (2 internal, 1 external, 1 driver monitor speaker).
- 1 Driver Microphone Input
- 3 Ambient Sensing Inputs
- 16 discrete inputs
- 3 discrete outputs
- 2 x SAE J1708
- 2 x SAE J1939 (CAN 250K)
- 5 x RS232
- 2 x RS485
- 1 x RS232 or RS485 (selectable)
- 7 x USB
- 4 x RJ45 Ethernet
- 1 x DVI
- 1 x HDMI
- Integrated 20-channel GPS with dead-reckoning, and Gyro-meter
- Integrated Wi-Fi capability supporting IEEE 802.11a, b, g, n
- Integrated cellular wireless capability
- Heavy-duty connectors
- Hardware & software feature expansion
- Built-in real-time clock

Environmental Requirements

At a minimum, the VLU shall be tested to the following requirements:

- Temp: SAE J1455 4.1.3.1, 4.1.3.2 (-30°C to +60°C)

- Humidity: SAE J1455 4.2
- Splash: SAE J1455 4.4
- Vibration: SAE J1455 4.9.4.1, 4.9.4.2
- Shock: SAE J1455 4.10.3.1, 4.10.3.4
- Load Dump: SAE J1455 4.11.2.2.1
- Ind. Switching: SAE J1455 4.11.2.2.2
- Mutual Coupling: SAE J1455 4.11.2.2.3
- Radiated Emissions: SAE J1113/41, SAE J1455 4.11.3.3.1
- Conducted Emissions: SAE J1113/41
- Radiated Interference Susceptibility: SAE J1455 4.11.3.3.2, SAE J1113/22/24
- Conducted Interference Susceptibility: SAE J1113/2
- ESD Handling: SAE J1455, J1113, J1211
- ESD in Vehicle: SAE J1455, J1113
- FCC CERTIFICATION: Emission FCC Part 15 Class A

Automated Voice Announcements

The VLU shall provide audio and visual announcements to on-board riders and those waiting to board. As each fixed-route vehicle approaches a stop or other designated location, a digitally-recorded announcement shall be automatically made in English and/or Spanish languages over the existing on-board public address (PA) system speakers and displayed on Dynamic Message Signs inside the vehicle to inform passengers about upcoming stops, major intersections and landmarks.

The VLU shall be capable of making time-based, location-based and vehicle operator-initiated announcements/displays.

The VLU shall make an exterior announcement of the current route number and destination when doors open at a stop. At other locations (e.g., major intersections), the VLU shall make preset location-based interior announcements.

The location information announced/displayed shall provide the stop name and transfer opportunities.

PA Volume Control

The volume of the internal announcements shall be automatically adjusted according to the noise level on the vehicle at the time, and the vehicle operator shall not be able to lower the announcement volume.

The VLU shall provide the capability to adjust external speaker volume levels based on time and location settings, as pre-configured by the Transit Agency (e.g., maximum volume at the downtown transfer center between 6am and 9am).

The VLU shall provide the capability to adjust the minimum and maximum volume levels separately for interior and exterior announcements.

The VLU announcements and PA volume level controls shall also allow the operator to separately adjust the volumes for the driver and handset speakers.

Automated Voice Announcement Triggers

The VLU shall use the vehicle location information to trigger the appropriate announcements on-board the vehicle whenever the vehicle enters a “trigger zone.” A trigger zone is a user-defined area that is located just prior to each stop location. For example, the trigger zone may begin 800 feet before a stop as well as at selected other announcement locations.

Trigger zones shall be pre-defined by the central software for VLU trigger management and downloaded to the controller over WLAN.

Time-based announcements/displays shall be programmed to be made on-board the vehicle at specific times of the day or at a set frequency within specified time periods, on specific days of the week.

Location-based announcements/displays shall be programmed to be made on-board the vehicle when that vehicle passes any designated location(s).

Automated announcements shall continue to operate normally when the Mobile Data Computer is in silent alarm mode.

In the event that a vehicle is operating off-route, the automated announcements/displays shall not be made. Once the route is reacquired, the system shall automatically determine and announce the next valid bus stop or other designated location.

Off-route and on-route detection and recovery shall be automatic and not require vehicle operator intervention or action.

Manual Announcements

The vehicle operator shall have the ability to manually trigger the activation of any pre-recorded announcements if needed.

Vehicle operator-initiated announcements/displays (e.g., safety-related announcements) shall be programmed to be made at the vehicle operator's discretion.

Vehicle operator use of the on-board PA system shall override any automated announcements.

Dispatchers shall be able to activate the announcements simultaneously on a group of buses.

Integration with Interior Dynamic Message Signs

The Contractor shall install new interior Dynamic Message Signs that shall communicate with Automated Voice Announcement controller over the J1708/1587 network.

Automated Voice Announcement Text Display

The VLU shall provide text announcements for configurable duration, which will be set using the central recording software.

As any fixed-route vehicle approaches a stop or other designated location, the VLU shall provide a stored text announcement at the same location as interior audio next stop announcement.

The VLU shall provide stored text for location triggered, periodic or operator-activated announcements.

The Dynamic Message Signs shall display the current date/time when not displaying a triggered announcement.

"Stop Requested" Functionality

The Dynamic Message Signs shall display the "stop requested" message when stop requested or the wheelchair area stop request is activated by a customer.

If stop request signal is received while another message is being displayed on the Dynamic Message Signs, the VLU shall show stop requested message after current message is completed.

If the next stop announcement begins while the stop requested message is displayed, the stop requested message shall be interrupted.

External Sign System Control

The VLU shall control the destination text to be displayed on the head-signs.

The Transit Agency shall provide and install any upgrades to the head-sign or head-sign controller firmware needed to implement this interface.

The operator shall continue to be able to use all features of the existing head-sign controller, regardless of whether or not the operator has logged into a run using the Transit Control Head (TCH) or whether the TCH/VLU are operational.

At an agency configurable distance before the start of each trip, the VLU shall change the head-sign message to display a message that can be configured by the Transit Agency.

When the vehicle is logged into a run using the TCH but operating on deadhead from the garage to the first trip of the run, the VLU shall automatically command the head-sign to display a message that can be configured by The Transit Agency. This message could be “OUTBOUND”, “INBOUND”, “OUT OF SERVICE”, “FROM GARAGE” or the message that will be displayed during the first trip.

When the vehicle is logged into a run using the TCH but operating on deadhead to the garage from the final trip of the run, the DTPW shall automatically command the head-sign to display a message that can be configured by the Transit Agency. This message could be “OUT OF SERVICE”, “TO GARAGE” or the message that will be displayed during the final trip.

When the vehicle is logged into a run using the TCH but operating on deadhead for interlining between trips in the course of a run, the VLU shall automatically command the head-sign to display a message that can be configured by the Transit Agency. This message could be “OUT OF SERVICE” or the message displayed during either the previous or upcoming trip.

When the vehicle is logged into a “special” run using the TCH, the VLU shall automatically command the head-sign to display a message that can be configured by the Transit Agency for that run (e.g., “OUT OF SERVICE”, “IN TRAINING”).

When the vehicle is logged into any run using the TCH, the operator shall be able to manually command the head-sign to display one of a set of preconfigured messages that can be configured by the Transit Agency (e.g., “OUT OF SERVICE”, “IN TRAINING”).

When the vehicle is in covert alarm mode, the VLU shall automatically command the head-sign to display one of a set of preconfigured messages that can be configured by the Transit Agency (e.g., “CALL POLICE”).

Vehicle Monitoring

The vehicle monitoring system shall automatically collect selected bus systems’ faults and operational performance data that will be transmitted simultaneously to the controller via the on board communication protocols (SAE J1939 Network, SAE J1708/J1587 Network, RS-232/485).

The system shall be capable of verifying active communication between all monitored systems and the system controller, and be capable of using multiple communication protocols simultaneously (SAE J1939 Network, SAE J1708/J1587 Network, RS232/485).

As system equipped vehicles come into range of the wireless LAN at the depot, all collected data (vehicle ID, all fault codes, and selected operational performance data defined in but not limited to Tables 2-1 to 2-6) shall be automatically transmitted to the Server and loaded into a format compatible with the depot system server.

All data shall be presented in US or Metric units as the Transit Authority desires. All data shall be capable of being presented using manufacturers fault and SAE definitions. Bus and sub-component manufacturers should provide all necessary documentation/support to ensure that all points are monitored properly with the actual fault/performance data point descriptions as they appear in all respective bus/sub-component maintenance manuals.

Manufactures should provide online access to Clever Devices On Board Integration Group to ensure that over the life of the bus, the most up to date configuration possible is provided to the Transit Agency. This shall include electronic copies of manuals, network topology diagrams, ladder logic, and gateway configurations as well as regular updates or access to an online hosted server. The OEM shall facilitate support from the parent company for all sub-component manufactures as needed and based upon the request of the Transit Agency. All faults and performance information shall be provided and shall be the functional equivalent of the any hand held or laptop based diagnostic unit unless approved by the Transit Agency. In addition to all standard SAE vehicle area network data points, all data point visualized on the operators’ dashboard and in any respective

bus/sub-component diagnostic software shall be broadcast on a SAE complaint vehicle area network making it available for monitoring by the IVS system.

When a gateway or an interface is used between controller and the onboard communication systems, the gateway shall output all data to the controller in the format that's compliant with section 3.2. A CANalyzer test and a data review shall be performed by the bus manufacturer to confirm all data availability. The OEM should provide a complete list of all available data points on the vehicle area network to support this process, this includes standard and proprietary data point addresses. The test result should be submitted to the Transit Agency for review prior to bus configuration audit.

The following documents should be submitted to the Transit Agency for technical review.

- List of all performance points that are capable of being monitored (for example, power train temperature and climate control compressor discharge pressure).
- List of all fault codes that are capable of being monitored (for example, engine code "2963", climate control fault code "6").
- Information above should be grouped by the system that is reporting the data (for example, Engine, HVAC, Multiplex, ABS and Door Control).
- Denote how each system communicates (for example, J1939, J1708, RS232/RS485).

Fault Events

All fault codes on the bus networks (SAE J1939, J1708/J1587, or RS232/RS485) shall be monitored, reported and stored in a non-volatile flash memory drive of the controller. Fault codes shall remain available indefinitely or as onboard memory storage permits. Data will be purged on a first in first out (FIFO) basis. Fault code data shall remain available after disconnecting the 24V batteries if disconnection occurs not less than 10 seconds after turning off the master run switch.

The system shall not collect faults when the engine is not running. The system shall not collect any data when the bus master switch is in the off position. Diagnostic fault codes (DM1, BAM or PID194, Multi-Section Parameter) from each system are to be monitored and the frequency of collection shall be configurable. Utilizing proprietary or reserved PGNs, SPNs, MIDs, FMIs, and PIDs are will not be accepted as they are not complaint with SAE J1587 or J1939 or the intention of this specification. Conditions or parameters for collecting fault codes based on either time delay or number of events in a time period shall be user definable. Condition or parameter changes will be made by supplier.

Performance Data

All performance data stored by IVS shall be stored in non-volatile flash memory of the controller. Performance data shall remain available indefinitely or as onboard memory storage permits. Data will be purged on a First In First Out basis. Performance data shall remain available after disconnecting the 24V batteries if disconnection occurs not less than 10 seconds after turning off the master run switch.

The transmitted performance data to be monitored, the frequency of collection, and the stamped count format will be defined in the technical proposal. Conditions or parameters for collecting fault codes based on either time delay or number of events in a time period shall be user definable. Condition or parameter changes will be made by supplier.

In addition, the system shall monitor the available performance data and diagnostic fault codes of the Methane Detection System, Alternative Fuel Storage/Delivery System (CNG, LNG, Propane, Hydrogen, Electric, Fuel Cell, Hybrid, etc...) and the Fire Suppression System.

Tables 2-1 through 2-8 list the minimum performance data signals that each system is required to output to the controller and complete list of all fault/performance data points shall be provided to the Transit Agency as part of the technical design review described herein.

The Contractor shall verify the diagnostic fault and performance signals referenced in this section since they depend on the model of engine, transmission and other systems that will be supplied in the bus. Utilizing proprietary or reserved PGNs, SPNs, MIDs, FMIs, and PIDs will not be accepted as they are not complaint

with SAE J1587 or J1939 or the intention of this specification. Any proprietary or reserved PGN may be rebroadcast on a compliant with SAE as described within this document.

Table 2-1 : Vehicle Signals			
No.	Signal Name	No.	Signal Name
1	Air Compressor Status (Duty Cycle)	16	Kneeling cycle count
2	Hard brake depression percent and computation of event counting. Comparison to throttle and break depression % with MPH/KPH at the time of the event. Tracking of the same data is required before and after the event. (See Section 3.3.4)	17	Rear Door Open Signal
3	Brake depression percent	18	Throttle depression percent
4	Odometer pulse (Square Wave). Must be delivered as a discrete Voltage signal to IVS	19	Total Vehicle Miles (or Kilometers) Traveled
5	Hydraulic tank level low indicator	14	Differential fluid low indicator
6	Hydraulic tank level high indicator	15	Front Door Open Signal
7	Transmission oil level low indicator	20	Trip distance in miles (or kilometers)
8	Transmission oil level high indicator	21	Vehicle speed (MPH or KPH)
9	Tail lamp out monitor	22	Wheel Chair Cycle Counts
10	Brake lamp out monitor	23	Bus Battery Voltage (12V, 24V and High Voltage system if applicable)
11	Headlight out monitor	24	All Available Diagnostic fault codes
12	Wheelchair – rate of deployment or system health (for example, amp draw of motor)	25	Air Compressor Pressure (Per individual tank and system pressure)
13	Charging system monitor – low charge indication (for example, < 25 VDC)		

T2-2: Engine			
No.	Signal Name	No.	Signal Name
1	All Diagnostic fault codes	9	Hours
2	Wheel-Based Vehicle Speed	10	Electrical Potential (Voltage)
3	Vehicle Identification Number	11	Date
4	Unit Number (Power Unit)	12	Number of Emergency Stops
5	Trip Distance	13	Software Identification (Calibration

T2-2: Engine			
No.	Signal Name	No.	Signal Name
			Version)
6	Total Vehicle Distance	14	Road Speed PGN65265 SPN84 at a consistent 100ms broadcast rate
7	Software Identification	15	Component Identification (Serial Number)
8	Maximum Vehicle Speed Limit		

Table 2-3: Transmission	
No.	Signal Name
1	All Diagnostic fault codes
2	Battery Potential (Voltage)
3	Engine Requested Speed/Speed Limit
4	Hydraulic Retarder Oil Temperature
5	Software Identification
6	Transmission Input Shaft Speed
7	Transmission Output Shaft Speed
8	Transmission Oil Temperature
9	Transmission Oil Level High/Low
10	Transmission Oil Life Remaining
11	Transmission Shift Position

Table 2-4: Multiplex System			
Performance data shall consist of but is not limited to current draw, electrical arcing to ground, system shutdown alerts and input and output status. At a minimum the multiplexer shall report the performance data given in the table below. The final list of the performance data will be finalized when the system configuration is made available by the Bus builder. The maximum number of signals required will depend on the multiplexer's capabilities. The system shall be able to add delay or persistency to these data points as required. Condition or parameter changes will be made by system supplier. For example, Low Air Fault can be generated and reported after a 15 second persistent with the engine running. NOTE: The J1939 compliant multiplexer system shall interface with the controller and transmit diagnostic fault codes (DM1, BAM or PID194, Multi-Section Parameter) available on the network. If a gateway is required for monitoring of the IVS system then a gateway shall be provided by the contracted bus builder.			
No.	Signal Name	No.	Signal Name
1	Reverse	16	Engine Start Cycles
2	Network Failure	17	Air Dryer/Drain Valve
3	Fuel Filter Service	18	Parking Brake
4	Engine Air Filter Service	19	Front door fully open
5	ABS Indicator	20	Front door fully closed

6	Alternator Charge Indicator	21	Fire Suppression System Alarm
7	Low Air Pressure	22	Fire-Engine Shutdown
8	Stop Engine	23	Fire System Ok
9	Kneel Down SW	24	Stop Requested (does not include wheel chair stop request)
10	Throttle Malfunction	25	Software Identification
11	A/C Failure	26	Transmission Shift Position
12	Wheel Chair Stop Request	27	Hazard Switch
13	Left Turn Signal	28	Seat Belt Status
14	Right Turn Signal	29	Climate Control Switch
15	Wheel Chair Ramp Deployed		

Table 2-5: ABS System	
No.	Signal Name
1	All diagnostic fault codes (DM1, BAM)
2	Road Speed
3	ABS Active
4	Software Identification
5	Wheel Speed PGN65215 SPN904 at a consistent 100ms broadcast rate

Table 2-6 : Door Systems	
No.	Signal Name
1	Diagnostic fault codes
2	Rear Door Count
3	Front Door Count
4	Wheelchair Cycles
5	Kneel Cycle Count
6	Emergency Override Switch Count

Table 2-7 : Climate Control System			
No.	Signal Name	No.	Signal Name
1	Ambient Air Temperature	10	Discharge Pressure
2	Application File	11	Suction Pressure
3	Discharge Air Temperature (Interior Cabin Air)	12	Operating Mode
4	Discharge Pressure	13	Evaporator Hours
5	Zone 1 Return Air Temperature	14	Condenser Hours

Table 2-7 : Climate Control System			
No.	Signal Name	No.	Signal Name
6	Zone 2 Return Air Temperature (only apply to articulation buses)	15	Configuration File
7	Zone 3 Return Air Temperature (only apply to articulation buses)	16	All diagnostic fault codes
8	Performance Data	17	Software Identification
9	Water Inlet Temperature	18	Compressor Hours
Note: Climate Control unit data shall be transmitted only when the operator's climate control switch is in the "ON" position. When the operator's climate control switch is in the "OFF" position, only software ID of the climate control unit would be transmitted to the system controller. If a second unit is installed on the bus, this shall broadcast the signals available.			

Table 2-8 : IVS	
No.	Signal Name
1	All IVS diagnostic fault codes (DM1, BAM)
2	All IVS software versions

AVM® Data Format and Availability

The automatic vehicle monitoring controller shall send and receive messages from all bus systems actively communicating and connected to the J1708 or J1939 networks.

Data Definition

Regardless of the communication protocol used, each bus sub-system supplier should provide an interface specification and data definition consistent with the provided interface. Manufacturers of systems to be monitored should provide documentation for the data to be transmitted for each system, the interface protocol to be used and the data definition of the externalized data. Bus Manufacturer should provide each system vendors with this appendix.

The bus manufacturer is responsible for monitoring bandwidth utilization to insure sufficient throughput for network traffic and must assure that there are no network collisions, frame errors, etc.

The bus manufacturer must ensure that any bus system supplier that makes programming changes keep the existing data available. If any new faults or performance data is added during any program change it must be made available as per the J1939, J1708/J1587, and RS-232/485 requirements. If changes do occur, the bus system supplier and the sub-system supplier must notify the Transit Agency of changes in writing. The bus system supplier and the sub-system supplier shall perform any necessary campaigns to ensure consistency by implementing changes across the entire fleet.

J1939 Bus System Fault Reporting and Performance Data

All bus system non-diagnostic application layer messages must be formatted and transmitted in conformance with SAE J1939-71, "Vehicle Application Layer". All performance data not made available through a broadcast must be available to system controller via the Request PGN (59904), as described in SAE J1939-

21, “Data Link Layer”. Utilizing proprietary or reserved PGNs or SPNs are will not be accepted as they are not complaint with J1939 or the intention of this specification.

All IVS monitored devices on SAE J1939 must respond to request for PGN 65242(Software Identification).

Bus System Fault Reporting (DM1 Diagnostic Messages)

All diagnostic (fault) application layer messages must conform to the requirements described in SAE J1939-73 “Application Layer – Diagnostics”.

At a minimum, all active bus system faults must be formatted and transmitted in accordance with paragraph 5.7.1 (“Active Diagnostic Trouble Codes (DTC)” – Message Type DM1 [PGN 65226]). These messages are to be broadcast, but shall also be available on request using the Request Message PGN [59904]. The Request PGN is described in J1939-21, “Data Link Layer”. The response to the DM1 request must be in accordance with paragraph 5.7.1 with regard to the formatting of DM1 messages. See “Transport Protocol”, below for details regarding transmission of multiple packets (containing DTCs) using the Broadcast Announce Message (BAM).

The DM1 message involves the use of Suspect Parameter Numbers (SPNs) to identify a particular element, component or parameter associated with a J1939 network device Diagnostic Trouble Code (DTC). Where possible, bus systems shall use SPNs defined in the SAE J1939 specification when reporting faults. If there is no correlation to an existing SPN, values in the proprietary range must be used. These are the SPN values which span from 520192 (7F000 hex) to 524287 (7FFFF hex), inclusive.

Transport Protocol - Broadcast Announce Message (BAM)

In all cases where a response or broadcast message will require greater than 8 data bytes, the capabilities of the Transport Protocol must be employed.

Specifically, the Broadcast Announce Message Transport Protocol, as described in SAE J1939-21, “Data Link Layer”, paragraph 5.10; provides for the transmission of messages which encompass multiple packets of data. An example of such a transmission would be a DM1 message with more than one Diagnostic Trouble Code (DTC) being reported.

J1587 Performance Data and Fault Reporting

J1587 Performance Data

All non-diagnostic or fault application layer status messages must be formatted and transmitted in conformance with SAE J1587, “Electronic Data Interchange Between Microcomputer Systems in Heavy Duty Vehicle Applications” and SAE J1708, “Serial Data Communications Between Microcomputer Systems in Heavy Duty Vehicle Applications”. All performance data is expected to be available via appropriate Message ID (MID), Parameter ID (PID), SID, Fault ID (FMI), assignments in accordance with these specifications. Utilizing proprietary or reserved FMIs, MIDs, and PIDs are will not be accepted as they are not complaint with SAE J1587 or the intention of this specification.

All IVS monitored devices on SAE J1708/J1587 must respond to request for PID 234 (Software Identification).

J1587 Fault Reporting

All diagnostic (fault) application layer messages must be formatted and transmitted in conformance with SAE J1587, “Electronic Data Interchange Between Microcomputer Systems in Heavy Duty Vehicle Applications” and SAE J1708, “Serial Data Communications Between Microcomputer Systems in Heavy Duty Vehicle Applications”. Specific attention shall be devoted to the use of PID 194 (Transmitter System Diagnostic Occurrence Count Table) to report the diagnostic condition of a device on the network. All fault reporting data is expected to be available via appropriate Message ID (MID), Parameter ID (PID), SID, Fault ID (FMI), assignments in accordance with these specifications.

J1587 Multi-Section Parameter

PID 192 (Multi-section Parameter) is used to transmit parameters that are longer than what is limited by SAE J1708. A specified parameter can be broken into sections with each section being transmitted in a different message. This shall be used as appropriate.

J1939 Compliant Devices Data Definition

All bus systems shall externalize all data including fault codes and performance data in a standard, non-proprietary J1939 format. All systems shall be assigned with a Source Address on the J1939 network. Specific detail for all Parameter Group Numbers (PGNs) supported (down to the individual parameters supported within the PGN) shall be provided to IVS supplier.

Details for each fault the device is capable of generating (using the DM1 message) shall include the Source Address (SA), Suspect Parameter Number (SPN), Fault ID (FMI), OEM Description and OEM Flash Code or Fault Code, if it exists. All bus systems shall also broadcast its software identification level to system controller.

J1587 Compliant Devices

All bus systems shall externalize all data including fault codes and performance data in a standard, non-proprietary J1587 format. MID on the J1587 (J1708) network and specific detail for all PIDs shall be provided to the automatic vehicle monitoring controller. Details for each fault the device is capable of generating (using the PID 194 message) shall include the MID, PID/SID, Fault ID (FMI), OEM Description and OEM Flash Code or Fault Code, if it exists. All bus systems shall also broadcast its software identification level to the automatic vehicle monitoring controller.

Multiplex System Monitoring

Multiplex systems shall be monitored via J1708/J1939 and/or RS232/485 and must be equipped with all necessary gateways and programming required to externalize data in a manner compatible with the automatic vehicle monitoring controller. Multiplex system sleep mode time shall be set to fifteen (15) minutes. The J1939 compliant multiplexer system shall interface with the IVS controller and transmit diagnostic fault codes (DM1, BAM or PID194, Multi-Section Parameter) available on the network .Interfacing may require a J1939 multiplexer gateway if a gateway is required it shall be provided by the contracted bus builder. Performance data to be supplied by bus manufacturer shall consist of but is not limited to current draw, electrical arcing, system shutdown alerts and input and output status.

Door System Interface

The IVS shall monitor the door system which may include door sensors that independently measure fully-open and fully-closed door positions. The bus must be equipped with open and close sensors on all doors. The system shall record all necessary fault codes broadcasted by door controller over the network used (J1939, J1708/J1587 or RS232/RS485).

The system shall be able to detect, calculate and record the opening and closing speed of all bus doors. The system will record and report a door open/close speed fault when the front door open/close speed is exceeding the speed and time defined.

Advanced technology and hybrid drivetrain systems

All advanced technology and hybrid drivetrain systems shall broadcast information in compliance specified SAE J1939 and J1708/J1587 vehicle area network communication standards contained within this appendix. All equivalent data points specified above by component system from standard diesel drivetrains shall be made available utilizing non-proprietary protocols.

The final list of fault and data points shall be subject to the Transit Agency review prior to final contract acceptance. Any required changes to firmware, harnessing, and other required interfaces shall be implemented fleet wide. If necessary the awarded contractor shall perform fleet wide upgrade campaigns as necessary to ensure compliance with this appendix.

Hard Brake and last stop reporting

The IVS should provide Hard Brake and Last Stop detection and reporting. The system shall utilize the most accurate available vehicle speed signal on the bus for Hard Brake and Last Stop. The system shall be able to use brake and acceleration signals from odometer pulse, ABS, transmission, etc. Hard Brake and Last Stop functionality is an investigative tool for use primarily for accident investigation. Hard Brake/Last Stop shall monitor, collect and report the following data while the bus is running:

- Event Time and Date
- Vehicle Speed (mph)
- Deceleration Rate (ft/sec^2)
- Engine Speed (rpm)
- Antilock Brake System Status (ABS Active)
- Bus ID
- Brake pedal position (applied or not-applied)
- Engine Load (%)
- Torque Commanded (Hybrid Vehicles)
- Throttle (%)

All the above data signals shall be externalized by the applicable system in a manner compatible and recognizable by the IVS controller. These signals will be consistently broadcast every 100ms. The collected data shall be stored when either a Hard Brake or Last Stop event occurs.

Hard brake detection shall be defined as vehicle decelerations that exceed a threshold of 15 ft/sec^2 for more than 300ms. The thresholds shall be configurable by the Transit Agency.

A Last Stop occurs whenever the bus comes to a full stop. Stored Hard Brake data remains in IVS controller until it is wirelessly transferred from the bus to a depot server or be manually copied from the bus. Stored Last Stop data shall be encrypted and only be manually copied from the bus.

A last stop event is defined as change in the vehicle's speed from forward motion to zero miles per hour. A hard brake will be considered as a last stop event if the hard brake event ends with 0 mph. The most recent five (5) last stop events shall be collected and stored on the IVS controller memory. Any last stop event other than the most recent five (5) last stop events will be deleted in the controller. Data collected for a last stop shall be the event itself and the data around the event which is called the snapshot data. The snapshot window shall be configurable from a minimum of two minutes before the event and one minute after the event. The most recent five (5) last stop events and associated snap shot data shall be continuously collected during the course of the day.

Hard brake and last stop accuracy shall be determined by comparing deceleration test results from the intelligent vehicle system and deceleration test equipment such as Vericom VC4000 or accelerometer. The error shall be within 5 percent.

Included with the Hard Brake/Last Stop functionality is the software tools required to upload and report Hard Brake and Last Stop events. For the Last Stop report generation, software shall be provided to the Transit Agency that allows authorized personnel to generate the report from the data that is copied from the bus. On the last stop reports, the time interval for each reading shall be one second minimum, preferably 500 milliseconds.

GPS and Dead Reckoning

The IVS shall have an onboard GPS unit. The GPS shall be comprised of self-contained hardware and software which includes a GPS receiver, gyrocompass and an interface to the odometer (available from the bus transmission).

Vehicle Communication Antenna

Wireless communication shall be IEEE 802.11 compliant. The system shall contain a multi-band antenna with cable that will allow the controller to have at a minimum GPS satellite communication, WIFI communication via IEEE 802.11, cellular communication. There shall be one antenna per bus. Antenna and cable shall have a service life equal to the design life of the bus. The bus manufacturer will install the antenna and the cable in conformance to this specification.

Transit Control Head (TCH)

The Transit Control Head (TCH), in conjunction with the VLU, should provide a single operator log-on for electronic devices on the transit vehicles, at the Authority's discretion, and be the sole driver interface for CleverCAD functions.

The TCH should provide a display and keypad which are specifically adapted for transit operations, and shall use a full color, touch screen, backlit display, readable by the vehicle operator from the seated position under the full range of ambient illumination conditions. This includes capability such as vehicle operator-controlled brightness/contrast control, anti-glare coating and adjustable orientation mounting. The color combination to be used on the TCH should provide legibility for the color blind.

The operator terminal shall be operated using touch screen programmable buttons with visual and audible feedback. The TCH speaker should provide audible feedback when a function key or on-screen key is pressed.

The operator shall not be able to manually shut off or disconnect the operator terminal power or manually shut down the Mobile Data Computer application software. Exposed antenna or other connections will be tamper-proof. If non-compliant, please provide information on how they will be made tamper-evident.

The TCH shall have the functionality to control both the destination signs and the voice annunciation system.

At a minimum, the TCH shall have the following hardware and characteristics:

- Overall size 10.00” long, 7.50” wide, and 1.80” in depth
- Weight: 3.5 lbs.
- VGA LCD screen, that is
  - 9 inch Wide Screen
  - 800 x 480 Resolution
  - R.G.B. Stripe Color Configuration
  - Daylight Readable
- VGA Touch Screen, that is
  - 3H Hard Coat, Film Glass
  - 83% Transparency with Anti-Glare and Anti-Smudge
  - Finger or Stylus Activated with maximum force of 80 Gf
  - Resistance Activated Touch
  - 10,000,000 Touch Lifespan
- Audio: speaker and microphone
- Brightness control via panel buttons
- Environmental
  - Temp: SAE J1455 4.1.3.1, 4.1.3.2 (-30°C to +70°C)
  - Humidity: SAE J1455 4.2
  - Vibration: SAE J1455 4.9.4.1, 4.9.4.2
  - Shock: SAE J1455 4.10.3.1, 4.10.3.4
  - FCC CERTIFICATION: Emission FCC Part 15 Class A

The Contractor shall install the Transit Control Head as close to the driver’s instrument panel as possible. The TCH has to be mounted in such a way that the driver will have a full view of the TCH display and the

mounting of this unit will not impede the view of the road. The proposed mounting location is to be reviewed and approved by DTPW prior to production.

Internal Display Sign

The internal display sign shall display coordinating text for next stop and other audio announcements. The sign shall meet all ADA requirements for internal signage.

The internal LED display sign shall be used to display the words “Stop Requested” and shall be visible to passengers. When the passenger chime is activated and shall remain on until the front or rear door is opened. The internal LED display sign shall also be used to display “Lift Requested” when the passenger chime is activated provided there are separate outputs on the vehicle to designate different chimes for Stop Requested and Lift Requested.

Enclosure shall be aluminum with welded and sanded seams, black powder paint finish and acrylic fascia with matte finish for reduction of reflected glare. Sign shall be constructed to withstand the harsh environmental conditions found in transit applications.

Speakers

Contractor shall provide a minimum of ten (10) interior speakers in the ceiling or lighting panels and one (1) exterior weather proof speaker at the front door. The speakers shall compatible with the Clever Devices IVN system and be capable of producing clear, high quality announcements. A 3-way selector switch must be provided for the manual P.A. system (inside/both/outside) so that the driver may select inside or outside or inside/outside announcements.

TS 81.3 Automatic Passenger Counter (APC)

The Urban Transportation Associates (UTA) Automatic Passenger Counter (APC) shall be furnished and installed by the Contractor. The APC will include features for wheelchair ramp and bike rack deployment.

DTPW approval is required for the installation of hardware and electrical wires prior to production.

TS 81.4 Radio Handset and Control System

The Contractor shall provide and install the complete radio system. The radio shall be a Harris M7300 Radio with OpenSky Trunking feature package, Control Unit, and an antenna system operating in 700/800 MHz range. (The Harris contact is Rick Rodriguez 305-423-0503 rick.rodriguez@harris.com) The Contractor shall provide and install a handset and cab speaker to work with the radio system. The Contractor shall provide wiring and specialized cables for the Clever Devices interface. The Contractor shall be responsible for coordinating radio interface details with Clever Devices. (The Clever Devices contact is David Mugica (817) 909-3285 DMugica@cleverdevices.com) The Contractor shall provide antennas and antenna cables, terminal blocks, filters, relays, and all wiring, connectors, brackets, and incidental hardware to install the complete system. All radio equipment location, accessibility, mounting, and cable routing must be approved by DTPW prior to production.
Regulated 13.6 volts DC power shall be provided for the radio system by the output of the dedicated electronics systems power supply.

Contractor should provide and install a 2-1/2 inch ID conduit or an equivalent inner wall channel space from the radio box to the radio control head mounting location. Conduit or channel design shall facilitate installation of the radio control cable by the "pull through" method in both initial and future installations to facilitate repair and replacement. Conduit shall be rust and water proof.

All antenna cables must be run in 1 inch diameter conduit to the radio box. Removable locking access covers shall be provided in the ceiling of the bus in order to allow access to the antenna and conduit. Antenna access cover locks must be approved by DTPW. The Contractor shall be responsible for the proper location and installation of all required antennas. Antenna locations shall be as close as possible to the centerline of the bus and have a separation of approximately 3 feet. All mounting locations must be approved by DTPW prior to bus manufacture.

TS 81.4.1 Drivers Speaker

The Cab speaker must be mounted so the driver can hear an announcement when the volume has been lowered.

DTPW will provide all Inter-Connect drawings. Mounting locations must be approved by DTPW prior to production.

TS 81.4.2 Handset

The Handset must be mounted at waist level (driver seated) requiring minimal body movement, located in front of the driver, and requiring minimal eye movement when locating the handset.

DTPW will provide all Inter-Connect drawings. Mounting locations must be approved by DTPW prior to production.

TS 81.4.3 Transit Control Head

Contractor shall install a driver display unit as close to the driver's instrument panel as possible.

The TCH has to be mounted in such a way that the driver will have a full view of the TCH display and the mounting of this unit will not impede the view of the road. The proposed mounting location is to be reviewed and approved by DTPW prior to production.

TS 81.4.4 Emergency Alarm

Contractor shall provide and install a Silent Alarm switch. The switch shall activate the Silent Alarm function of the radio system and destination sign. The switch shall be a red push button double pole switch with guard ring, manufactured by OTTO Engineering, part P/N P4-624122. The push button must be red and have a protective collar to prevent accidental activation. The installation and location of the switch must be approved by DTPW prior to production.

An emergency anti-highjack function shall be provided which will activate the throttle interlock and the transmission auto neutral features when inputs are provided by the radio system. (The transmission"auto neutral" feature is activated when the transmission "auto neutral" input wire is grounded.) The radio VLU will utilize two of its normally open dry contacts to provide ground inputs to the I/O Controls (or approved equal) programmable logic system. One contact will provide the signal to activate the anti-highjack function to disable the bus. The bus will remain disabled until the other contact provides a signal to de-activate the anti-highjack function.

The intent of these specifications is to have the Contractor provide and install a complete and functional radio system.

TS 81.5 Wireless Router

WiFi Equipment (In-Motion Mobile Gateways Including Both Internal and External Antennas)

The contractor shall provide for one integrated, modular wireless bus system with both 802.11n and the highest speed available wireless cellular data packet technology available at the time of design. The system shall include, but is not limited to an InMotion internal LTE modem, model IMTGOMG2040-00 (Dual Wi-Fi, USB/Express, Dual Cellular-ready) compatible with AT&T's network in addition to Miami-Dade Transit's standard requirement of GPS radio, Wi-Fi card for public use, Wi-Fi card for backhaul use, and slots for additional modems. The contractor shall provide one onboard Mobility Core Server Software License per Gateway. The overall wireless system description shall be provided to DTPW for review and approval prior to production.

Modularity

The Wireless Router system must be of modular design so as to allow for the upgrade and replacement of wireless and cellular cards via a card swap. The Wireless routers software must be capable of being upgraded via a software modification to be covered under the equipment maintenance in the event that 802.11n is not available at the time of design.

Wireless Router Antennas

The Wireless router shall have antennas installed on the bus and positioned for optimal data coverage and transfer from the bus. The antennas must support MIMO type design as is being used currently on advanced 802.11g systems and will be the standard on 802.11n type systems. Antennas must be rated for mobile applications and be built and designed strong enough to be used through a vehicle wash without any problems. Proper gaskets and sealing of antennas will be made on the bus structure to prevent leaks through antenna placements.

The cellular antenna shall be for 4G LTE service.

Security

A minimum of WPA2-AES security will be required on the Wireless Router. If at the time of design, security flaws have been found in WPA2. DTPW will require an DTPW approved security scheme. Router will be configured so only key systems will be allowed to transfer off the cellular link with the use of a built in system firewall.

Traffic Prioritization

Selected Wireless Router system must be capable of tagging traffic with prioritization levels as defined in 802.11e QoS. Prioritization levels will need to be different for the 802.11n and the cellular links. Levels will be chosen based on the application needs during design review.

Bandwidth/Coverage

802.11n

Wireless router shall provide at a minimum 100Mbps full duplex connectivity at a distance of 100FT from the antenna. The baseline 802.11n product that must be used to test the reference design will be composed of a similar wireless router without the use of amplification technology and with the use of omni antennas with more than 2.5dbi. Bandwidth/Coverage shall be tested by sending bit patters over the link with no more that 1% packet errors and 0% packet loss.

Cellular

At a distance of 400FT from the 802.11n antenna or greater the Wireless Routers will seamlessly switch to use the cellular technology. Coverage of the system must provide for at a minimum of 85-90% coverage area

along current DTPW bus routes at the time of design. Coverage will be determined by use of providers wireless coverage maps.

Interconnectivity

Wireless Router system selected must be capable of bridging or routing to another similar wayside device to bring communications back to the Government Center servers. MobileIP or approved mobility protocols shall be used to provide seamless transition from 802.11n to the wireless cellular network and back when in 802.11n coverage.

Description of Current DTPW Wireless Infrastructure:

Mobile Access Routers are currently used to support Mobile-IP for connection persistence as a device roams from one area to another. It is the intention of DTPW to implement a system that will allow DTPW to utilize the IEEE 802.16 standard in conjunction with vertical cellular handoffs. IEEE802.16 is currently implemented using a Cisco based VPN/Home Agent/FW and ACS server infrastructure.

Onboard Device Connectivity

Wireless system must have sufficient Ethernet 10/100 ports required to support all subsystems that require communications to wayside equipment via wireless or cellular. In addition there must be a minimum of 4 Ethernet ports left available for future growth.

A network cable shall be provided between the In-Motion mobile gateway and the DVR.

TS 81.6 Communications Equipment Box

Provide a lockable communications equipment box in the forward most streetside compartment. The box shall accommodate radio (including VLU), CCTV, Clever Devices voice annunciator/PA, DC-DC converter, and other electronic equipment. The equipment shall be mounted in the box on slide-out trays or racks. The trays or racks shall slide out so that the equipment is completely out of the radio box and access to wires, cables, and hard drive is easily accessible. The trays or racks must lock in the stowed position. Provide a terminal block with 16 terminal posts on the radio tray (location to be approved by DTPW Communications). Terminal lugs 1 and 2 must have constant 12VDC. Lugs 4 must have switched 12VDC-ignition voltage. Terminal lug 6 must be power ground. Lugs 7 through 16 will be used as needed. Equipment shall be mounted with sufficient room to easily secure cables and so that securing the cable to the equipment requires orienting the screwdriver from above or toward the bus centerline. The box shall be sealed to prevent intrusion of dust and water. The box must have an access door that is lockable with a ChicagoLOCK 1454 key. The design of the communications equipment box must be approved by DTPW prior to production.

Provide a 24VDC power outlet in the compartment, powered only when the engine is running, for use with a 24VDC to 120VAC-15AMP inverter.

A permanent vinyl schematic on the communications equipment box door illustrating configuration shall be provided.

WARRANTY REQUIREMENTS

WR 1. Basic Provisions

WR 1.1 Warranty Requirements

WR 1.1.1 Contractor Warranty

Warranties in this document are in addition to any statutory remedies or warranties imposed on the Contractor. Consistent with this requirement, the Contractor warrants and guarantees to DTPW each complete bus, and specific subsystems and components as follows.

WR 1.1.2 Complete Bus

The complete bus, propulsion system, components, major subsystems, and body and chassis structure, are warranted to be free from Defects and Related Defects for three years / unlimited miles~~, whichever comes first,~~ beginning on the date each bus is put into service. Items with progressive wear characteristics such as but not limited to belts, wiper blades, friction materials, etc. are not excluded from warranty and should not be of poor quality that requires frequent change. The warranty shall not apply to scheduled maintenance items such as filters and consumable items. Consumable items are only oil and lubricants. The warranty is based on regular operation of the bus under the operating conditions prevailing in Miami, Florida. Specific warranties for subsystems and components that exceed the three years / unlimited miles complete bus warranty are listed in subsequent Sections. During this warranty period, the bus shall maintain its structural and functional integrity.

WR 1.1.3 Subsystems and Components

Specific subsystems and components are warranted and guaranteed to be free from defects and related defects for the time and/or mileages given.

The following warranty periods and/or mileage shall apply:

MAJOR SUBSYSTEM AND COMPONENT WARRANTY TABLE

		Whichever occurs first
Item	**Years**	**Mileage**
Powertrain	5	Unlimited
Air Compressor	5	Unlimited
Air Dryer	5	Unlimited
Batteries	12	Unlimited
Charging Equipment	12	Unlimited
Push Button Shift Selector (PBBS)	5	Unlimited
Drive Shaft	1	50,000
Drive Axle	2	150,000
Suspension Components	3	150,000
Brake System	2	150,000
All Electric HVAC	3	Unlimited
Passenger Door System	3	150,000
Wheelchair Ramp System	3	Unlimited
Fire Suppression System	3	150,000

Passenger Seating	3	150,000
Paint System	3	150,000
Windows Frame (Water leak and Condensation)	2	150,000
Floor (Including floor cover)	12	Unlimited
Basic Body Structure	12	Unlimited
Body Structure Corrosion	12	Unlimited

Extended Warranties terms and prices of all major subsystems and components greater than those listed above shall be provided by the Contractor and priced separately from the bus in the Price Proposal. DTPW shall have the option to purchase the extended warranty for all major subsystems and components.

WR 1.1.4 Serial Numbers

Upon delivery of each bus, the Contractor shall provide a complete electronic list of serialized units installed on each bus to facilitate warranty tracking. The list shall include, but is not limited to:

- Powertrain
- Charging Station
- A/C compressor and condenser/evaporator unit
- drive axle
- power steering unit
- air compressor
- wheelchair ramp

The Contractor shall provide updated serial numbers resulting from warranty campaigns. The format of the list shall be approved by the Agency prior to delivery of the first production bus.

WR 1.1.5 Extension of Warranty

If, during the warranty period, repairs or modifications on any bus are made necessary by defective design, materials or workmanship but are not completed due to lack of material or inability to provide the proper repair for thirty (30) calendar days, the applicable warranty period shall be extended by the number of days equal to the delay period.

WR 1.2 Voiding of Warranty

The warranty shall not apply to any part or component of the bus that has been subject to misuse, negligence, accident, or that has been repaired or altered in any way as to affect adversely its performance or reliability, except insofar as such repairs were in accordance with Contractor's maintenance manuals and the workmanship was in accordance with recognized standards of the industry. The warranty shall also be void if DTPW fails to conduct normal inspections and scheduled preventive maintenance procedures as recommended in the Contractor's maintenance manuals. This clause shall be effective upon the receipt of all the contractor's maintenance manuals by DTPW.

WR 1.3 Exceptions and Additions to Warranty

The warranty shall not apply to scheduled maintenance items and items furnished by DTPW such as radios except if such equipment may be damaged by the failure of a part or component for which the Contractor is responsible.

WR 1.3.1 Pass-Through Warranty

Should the Contractor elect to not administer warranty claims on certain components and wish to transfer this responsibility to the sub-Suppliers, or to others, the Contractor shall request this waiver.

Contractor shall state in writing that the Agency's warranty reimbursements will not be impacted. The Contractor also shall state in writing any exceptions and reimbursement including all costs incurred in transport of vehicles and/or components. At any time during the warranty period, the Contractor may request approval from the Agency to assign its warranty obligations to others, but only on a case-by-case basis approved in writing by the Agency. Otherwise, the Contractor shall be solely responsible for the administration of the warranty as specified. Warranty administration by others does not eliminate the warranty liability and responsibility of the Contractor.

WR 1.3.2 Superior Warranty

The Contractor shall pass on to the Agency any warranty offered by a component Supplier that is superior to that required herein. The Contractor shall provide a list to the Agency noting the conditions and limitations of the Superior Warranty not later than the start of production. The Superior Warranty shall not be administered by the Contractor.

WR 1.4 Fleet Defects

WR 1.4.1 Occurrence and Remedy

A Fleet Defect is defined as cumulative failures of twenty-five (25) percent of the same components in the same or similar application in a minimum fleet size of twelve (12) or more buses where such items are covered by warranty. A Fleet Defect shall apply only to the base warranty period in sections entitled "Complete Bus," "Propulsion System" and "Major Subsystems." When a Fleet Defect is declared, the remaining warranty on that item/component stops. The warranty period does not restart until the Fleet Defect is corrected.

For the purpose of Fleet Defects, each option order shall be treated as a separate bus fleet. In addition, should there be a change in a major component within either the base order or an option order, the buses containing the new major component shall become a separate bus fleet for the purposes of Fleet Defects.

The Contractor shall correct a Fleet Defect under the warranty provisions defined in "Repair Procedures." After correcting the Defect, DTPW and the Contractor shall mutually agree to and the Contractor shall promptly undertake and complete a work program reasonably designed to prevent the occurrence of the same Defect in all other buses and spare parts purchased under this Contract. Where the specific Defect can be solely attributed to particular identifiable part(s), the work program shall include redesign and/or replacement of only the defectively designed and/or manufactured part(s). In all other cases, the work program shall include inspection and/or correction of all of the buses in the fleet via a mutually agreed-to arrangement. The Contractor shall update, as necessary, technical support information (parts, service and operator's manuals) due to changes resulting from warranty repairs. DTPW may immediately declare a Defect in design resulting in a safety hazard to be a Fleet Defect. The Contractor shall be responsible to furnish, install and replace all defective units.

WR 1.4.2 Exceptions to Fleet Defect Provisions

The Fleet Defect warranty provisions shall not apply to DTPW-supplied items, such as radios, fare collection equipment, communication systems and tires.

WR 2. Repair Procedures

WR 2.1 Repair Performance

The Contractor is responsible for all warranty-covered repair Work. To the extent practicable, DTPW will allow the Contractor or its designated representative to perform such Work. At its discretion, DTPW may perform such Work if it determines it needs to do so based on transit service or other requirements. Such Work shall be reimbursed by the Contractor.

WR 2.2 Repairs by the Contractor

If DTPW detects a Defect within the warranty periods defined in this section, it shall, within thirty (30) days, notify the Contractor's designated representative. The Contractor or its designated representative shall, if requested, begin work on warranty-covered repairs within five calendar days after receiving notification of a Defect from DTPW. DTPW shall make the bus available to complete repairs timely with the Contractor's repair schedule.

The Contractor shall provide at its own expense all spare parts, tools and space required to complete repairs. At the DTPW's option, the Contractor may be required to remove the bus from the DTPW's property while repairs are being affected. If the bus is removed from the DTPW's property, repair procedures must be diligently pursued by the Contractor's representative.

WR 2.3 Repairs by the Agency

WR 2.3.1 Parts Used

If the Agency performs the warranty-covered repairs, it shall correct or repair the Defect and any Related Defects utilizing parts supplied by the Contractor specifically for this repair. At its discretion, the Agency may use Contractor-specified parts available from its own stock if deemed in its best interests.

WR 2.3.2 Contractor-Supplied Parts

DTPW may require that the Contractor supply parts for warranty-covered repairs being performed by the Agency. Those parts may be remanufactured but shall have the same form, fit and function, and warranty. The parts shall be shipped prepaid to the Agency from any source selected by the Contractor within fourteen (14) days of receipt of the request for said parts and shall not be subject to an DTPW handling charge.

WR 2.3.3 Defective Component Return

The Contractor may request that parts covered by the warranty be returned to the manufacturing plant. The freight costs for this action shall be paid by the Contractor. Materials should be returned in accordance with the procedures outlined in "Warranty Processing Procedures."

WR 2.3.4 Failure Analysis

The Contractor shall, upon specific request of DTPW, provide a failure analysis of Fleet Defect or safety-related parts, or major components, removed from buses under the terms of the warranty that could affect fleet operation. Such reports shall be delivered within 60 days of the receipt of failed parts.

WR 2.3.5 Reimbursement for Labor and Other Related Costs

DTPW shall be reimbursed by the Contractor for labor. The amount shall be determined by multiplying the number of man-hours actually required to diagnose and correct the defect by the current rate per hour, first class mechanic, straight wage rate, plus seventy percent (70%) fringe benefits, plus the cost of towing the bus if such action was in the normal service area. These wage and fringe benefit rates shall not exceed the rates in effect in DTPW's service garage at the time the defect correction is made. Labor required to correct fleet defects shall be reimbursed at one and one-half (1 1/2) the actual rate in effect at the time the campaign is made, plus seventy percent (70%) fringe benefits.

WR 2.3.6 Reimbursement for Parts

The Agency shall be reimbursed by the Contractor for defective parts and for parts that must be replaced to correct the Defect. The reimbursement shall be at the current price at the time of repair and shall include taxes where applicable, plus fifteen (15) percent handling costs. Handling costs shall not be paid if part is supplied by Contractor and shipped to Agency.

WR 2.3.7 Reimbursement Requirements

The Contractor shall respond to the warranty claim with an accept/reject decision including necessary failure analysis no later than sixty (60) days after DTPW submits the claim and defective part(s), when requested. Reimbursement for all accepted claims shall occur no later than sixty (60) days from the date of acceptance of a valid claim. DTPW may dispute rejected claims or claims for which the Contractor did not reimburse the full amount. The parties agree to review disputed warranty claims during the following quarter to reach an equitable decision to permit the disputed claim to be resolved and closed. The parties also agree to review all claims at least once per quarter throughout the entire warranty period to ensure that open claims are being tracked and properly dispositioned.

WR 2.4 Warranty after Replacement/Repairs

If any component, unit or subsystem is repaired, rebuilt or replaced by the Contractor or by DTPW with the concurrence of the Contractor, the component, unit or subsystem shall have the unexpired warranty period of the original. Repairs shall not be warranted if the Contractor-provided or authorized parts are not used for the repair, unless the Contractor has failed to respond within five days, in accordance with “Repairs by the Contractor.”

If an item is declared to be a Fleet Defect, the warranty stops with the declaration of the Fleet Defect. Once the Fleet Defect is corrected, the item(s) shall have three (3) months or remaining time and/or miles of the original warranty, whichever is greater. This remaining warranty period shall begin on the repair/replacement date for corrected items on each bus if the repairs are completed by the Contractor or on the date the Contractor provides all parts to DTPW.

WR 2.4.1 Warranty Processing Procedures

The following list represents requirements by the Contractor to the Agency for processing warranty claims. One failure per bus per claim is allowed.

- bus number and VIN
- total vehicle life mileage at time of repair
- date of failure/repair
- acceptance/in-service date
- Contractor part number and description
- component serial number
- description of failure
- all costs associated with each failure/repair (invoices may be required for third-party costs):
    - towing
    - road calls
    - labor
    - materials
    - parts
    - handling
    - troubleshooting time

WR 2.5 Forms

The Agency’s forms will be accepted by the Contractor if all of the above information is included. Electronic submittal may be used if available between the Contractor and Agency.

WR 2.6 Return of Parts

When returning defective parts to the Contractor, the Agency shall tag each part with the following:

- bus number and VIN
- claim number
- part number
- serial number (if available)

WR 2.7 Timeframe

Each claim must be submitted no more than thirty (30) days from the date of failure and/or repair, whichever is later. All defective parts must be returned to the Contractor, when requested, no more than forty-five (45) days from date of repair.

WR 2.8 Reimbursements

Reimbursements are to be transmitted to Miami-Dade County.

QUALITY ASSURANCE

QA 1. Contractor's In-Plant Quality Assurance Requirements

Quality Assurance Plan

The Contractor shall develop and submit an effective Quality Assurance Plan (QAP) and associated quality procedures for review and approval. The Contractor's QAP shall, at a minimum, adhere to and contain elements corresponding to the FTA Quality Management System (QMS) Guidelines (FTA-PA-27-5194-12.1) or in line with the ISO 9001 QMS guidelines.
The QAP shall ensure compliance with the requirements of the contract documents within the Contractor's, subcontractor's and supplier's organizations. The FTA QMS Guidelines web link is provided to the Contractor as a reference document to assist with the preparation and approval of the QAP which is located at the following link:

http://www.fta.dot.gov/FINAL_FTA_QMS__Guidelines_December_2012.pdf.

Note: Refer to Chapter 2 on page 2-1 of the guidelines link for the details on the fifteen (15) quality elements that need to be included in the QAP as specified above. In addition to the link on the FTA QMS Guidelines, a **QAP template shall be attached to the contract documents for further guidance in the development of the Contractors QAP.**

QA 1.1 Quality Assurance Organization

QA 1.1.1 Organization Establishment

The Contractor shall establish and maintain an effective in-plant quality assurance organization. It shall be a specifically defined organization and should be directly responsible to the Contractor's top management.

The Contractor shall designate a Quality Assurance Representative (QAR) experienced in the quality requirements of the Contract. The QAR shall be Quality Assurance Professional with experience in quality management of capital projects in accordance with the FTA QMS Guidelines and/or ISO 9001series standards. The QAR shall be given sufficient authority to ensure that the quality is consistently maintained. The Contractor should provide DTPW with the organizational chart and resume of the QAR for review and approval as part of the QAP submittal requirements. The QAR shall not be replaced by the Contractor without prior approval of DTPW.

QA 1.1.2 Control

The quality assurance organization shall exercise quality control over all phases of production, from initiation of design through manufacture and preparation for delivery. The organization shall also control the quality of supplied articles.

QA 1.1.3 Authority and Responsibility

The quality assurance organization shall have the authority and responsibility for reliability, quality control, inspection planning, establishment of the quality control system, and acceptance/rejection of materials and manufactured articles in the production of the transit buses.

QA 1.2 Quality Assurance Organization Functions

QA 1.2.1 Minimum Functions

The quality assurance organization shall include the following minimum functions:

- **Work instructions:** The quality assurance organization shall verify inspection operation instructions to ascertain that the manufactured product meets all prescribed requirements.
- **Records maintenance:** The quality assurance organization shall maintain and use records and data essential to the effective operation of its program. These records and data shall be available for review by the resident inspectors. Inspection and test records for this procurement shall be available for a minimum of one year after inspections and tests are completed.
- **Corrective action:** The quality assurance organization shall detect and promptly ensure correction of any conditions that may result in the production of defective transit buses. These conditions may occur in designs, purchases, manufacture, tests or operations that culminate in defective supplies, services, facilities, technical data or standards.

QA 1.2.2 Basic Standards and Facilities

The following standards and facilities shall be basic in the quality assurance process:

- **Configuration control:** The Contractor shall maintain drawings, assembly procedures, and other documentation that completely describe a qualified bus that meets all of the options and special requirements of this procurement. The quality assurance organization shall verify that each transit bus is manufactured in accordance with these controlled drawings, procedures, and documentation.
- **Measuring and testing facilities:** The Contractor shall provide and maintain the necessary gauges and other measuring and testing devices for use by the quality assurance organization to verify that the buses conform to all specification requirements. These devices shall be calibrated at established periods against certified measurement standards that have known, valid relationships to national standards.
- **Production tooling as media of inspection:** When production jigs, fixtures, tooling masters, templates, patterns, and other devices are used as media of inspection, they shall be proved for accuracy at formally established intervals and adjusted, replaced, or repaired as required to maintain quality.
- **Equipment use by resident inspectors:** The Contractor's gauges and other measuring and testing devices shall be made available for use by the resident inspectors to verify that the buses conform to all specification requirements. If necessary, the Contractor's personnel shall be made available to operate the devices and to verify their condition and accuracy.

QA 1.2.3 Maintenance of Control

The Contractor shall maintain quality control of purchases:

- **Supplier control:** The Contractor shall require that each Supplier maintains a quality control program for the services and supplies that it provides. The Contractor's quality assurance organization shall inspect and test materials provided by Suppliers for conformance to specification requirements.

Materials that have been inspected, tested, and approved shall be identified as acceptable to the point of use in the manufacturing or assembly processes. Controls shall be established to prevent inadvertent use of nonconforming materials.

- **Purchasing data:** The Contractor shall verify that all applicable specification requirements are properly included or referenced in purchase orders of articles to be used on transit buses.

QA 1.2.4 Manufacturing Control

- **Controlled conditions:** The Contractor shall ensure that all basic production operations, as well as all other processing and fabricating, are performed under controlled conditions. Establishment of these controlled conditions shall be based on the documented Work instructions, adequate production equipment and special working environments if necessary.
- **Completed items:** A system for final inspection and test of completed transit buses shall be provided by the quality assurance organization. It shall measure the overall quality of each completed bus.
- **Nonconforming materials:** The quality assurance organization shall monitor the Contractor's system for controlling nonconforming materials. The system shall include procedures for identification, segregation and disposition.
- **Statistical techniques:** Statistical analysis, tests and other quality control procedures may be used when appropriate in the quality assurance processes.
- **Inspection status:** A system shall be maintained by the quality assurance organization for identifying the inspection status of components and completed transit buses. Identification may include cards, tags or other normal quality control devices.

QA 1.2.5 Inspection System

The quality assurance organization shall establish, maintain and periodically audit a fully documented inspection system. The system shall prescribe inspection and test of materials, Work in process and completed articles. As a minimum, it shall include the following controls:

- **Inspection personnel:** Sufficient trained inspectors shall be used to ensure that all materials, components and assemblies are inspected for conformance with the qualified bus design.
- **Inspection records:** Acceptance, rework or rejection identification shall be attached to inspected articles. Articles that have been accepted as a result of approved materials review actions shall be identified. Articles that have been reworked to specified drawing configurations shall not require special identification. Articles rejected as unsuitable or scrap shall be plainly marked and controlled to prevent installation on the bus. Articles that become obsolete as a result of engineering changes or other actions shall be controlled to prevent unauthorized assembly or installation. Unusable articles shall be isolated and then scrapped. Discrepancies noted by the Contractor or resident inspectors during assembly shall be entered by the inspection personnel on a record that accompanies the major component, subassembly, assembly, or bus from start of assembly through final inspection. Actions shall be taken to correct discrepancies or deficiencies in the manufacturing processes, procedures or other conditions that cause articles to be in nonconformity with the requirements of the Contract specifications. The inspection personnel shall verify the corrective actions and mark the discrepancy record. If discrepancies cannot be corrected by replacing the nonconforming materials, then the Agency shall approve the modification, repair or method of correction to the extent that the Contract specifications are affected.
- **Quality assurance audits:** The quality assurance organization shall establish and maintain a quality control audit program. Records of this program shall be subject to review by the Agency.

QA 2. Inspection

QA 2.1 Inspection Stations

Inspection stations shall be at the best locations to provide for the Work content and characteristics to be inspected. Stations shall provide the facilities and equipment to inspect structural, electrical, hydraulic and other components and assemblies for compliance with the design requirements.

Stations shall also be at the best locations to inspect or test characteristics before they are concealed by subsequent fabrication or assembly operations. These locations shall minimally include underbody structure completion, body framing completion, body prior to paint preparation, water test, engine installation completion, underbody dress-up and completion, bus prior to final paint touchup, bus prior to road test and bus final road test completion.

QA 2.2 Resident Inspectors

QA 2.2.1 Resident Inspector's Role

The Agency shall be represented at the Contractor's plant by resident inspectors, as required by FTA. Resident inspectors may be Agency employees or outside contractors. The Agency shall provide the identify of each inspector and shall also identify their level of authority in writing. They shall monitor, in the Contractor's plant, the manufacture of transit buses built under the procurement. The presence of these resident inspectors in the plant shall not relieve the Contractor of its responsibility to meet all of the requirements of this procurement. The Agency shall designate a primary resident inspector, whose duties and responsibilities are delineated in "Pre-Production Meetings," "Authority" and "Pre-Delivery Tests," below. Contractor and resident inspector relations shall be governed by the guidelines included as Attachment A to this "Section 8: Quality Assurance."

QA 2.2.2 Pre-Production Meetings

The primary resident inspector may participate in design review and pre-production meetings with the Agency. At these meetings, the configuration of the buses and the manufacturing processes shall be finalized, and all Contract documentation provided to the inspector.

No less than thirty (30) days prior to the beginning of bus manufacture, the primary resident inspector may meet with the Contractor's quality assurance manager and may conduct a pre-production audit meeting. They shall review the inspection procedures and finalize inspection checklists. The resident inspectors may begin monitoring bus construction activities two weeks prior to the start of bus fabrication.

QA 2.2.3 Authority

Records and data maintained by the quality assurance organization shall be available for review by the resident inspectors. Inspection and test records for this procurement shall be available for a minimum of one year after inspections and tests are completed.

The Contractor's gauges and other measuring and testing devices shall be made available for use by the resident inspectors to verify that the buses conform to all specification requirements. If necessary, the Contractor's personnel shall be made available to operate the devices and to verify their condition and accuracy.

Discrepancies noted by the resident inspector during assembly shall be entered by the Contractor's inspection personnel on a record that accompanies the major component, subassembly, assembly or bus from start of assembly through final inspection. Actions shall be taken to correct discrepancies or deficiencies in the manufacturing processes, procedures or other conditions that cause articles to be in nonconformity with the requirements of the Contract specifications. The inspection personnel shall verify the corrective actions and mark the discrepancy record. If discrepancies cannot be corrected by replacing the nonconforming materials, the Agency shall approve the modification, repair or method of correction to the extent that the Contract specifications are affected.

The primary resident inspector shall remain in the Contractor's plant for the duration of bus assembly Work under this Contract. Only the primary resident inspector or designee shall be authorized to release the buses for delivery. The resident inspectors shall be authorized to approve the pre-delivery acceptance tests. Upon request to the quality assurance supervisors, the resident inspectors shall have access to the Contractor's quality assurance files related to this procurement. These files shall include drawings, assembly procedures, material standards, parts lists, inspection processing and reports, and records of Defects.

QA 2.2.4 Support Provisions

The Contractor shall provide office space for the resident inspectors in close proximity to the final assembly area. This office space shall be equipped with desks, outside and interplant telephones, Internet access, file cabinet and chairs.

QA 2.2.5 Compliance with Safety Requirements

At the time of the Pre-Production meeting, the Contractor shall provide all safety and other operational restrictions that govern the Contractor's facilities. These issues will be discussed and the parties will agree which rules/restrictions will govern the Agency's inspector(s) and any other Agency representatives during the course of the Contract.

QA 3. Acceptance Tests

QA 3.1 Responsibility

Fully documented tests shall be conducted on each production bus following manufacture to determine its acceptance to the Agency. These acceptance tests shall include pre-delivery inspections and testing by the Contractor and inspections and testing by the Agency after the buses have been delivered.

QA 3.2 Pre-Delivery Tests

The Contractor shall conduct acceptance tests at its plant on each bus following completion of manufacture and before delivery to DTPW. These pre-delivery tests shall include visual and measured inspection, as well as testing the total bus operation. The tests shall be conducted to ensure that the completed buses have attained the desired quality and have met the requirements in the Technical Specifications. The tests shall be conducted in accordance with written tests plans and shall be recorded on appropriate test forms provided by the Contractor. The pre-delivery tests shall be scheduled with sufficient notice so that they may be witnessed by the Resident Inspectors, who may reject the results of the tests. The results of pre-delivery tests, or any other tests, shall be filed with the assembly inspection records for each bus. The underfloor equipment shall be made available for inspection by the Resident Inspectors using a pit or bus hoist provided by the Contractor. A hoist, scaffold, or elevated platform shall be provided by the Contractor to easily and safely inspect bus roofs. Delivery of each bus shall require written authorization of a Resident Inspector. Authorization forms for the release of each bus for delivery shall be provided by the Contractor. An executed copy of the authorization shall accompany the delivery of each bus. Failure to provide adequate inspection facilities for the Resident Inspectors will result in no-shipment of buses from the production plant without relief from liquidated damages due to schedule delays.

All buses shall be subjected to water tests simulating the severe rain conditions experienced in the South Florida environment. Windows, escape hatches, doors, etc. are subject to an approved water test to be conducted at the manufacturers facility by the manufacturer and shall be observed by the Resident Inspector(s). Water testing may be verified by further testing at Miami Dade County's Maintenance Facility prior to the acceptance of each vehicle if test observation or verification of leak repair is missed on or not observed by the Resident Inspector on any bus built for Miami Dade County. Any bus that fails to pass the water test shall be corrected by the contractor. The retest/corrective repair cycle shall repeat until the leak(s) have been eliminated to Miami Dade County's satisfaction.

The Agency may, prior to commencement of production, demand that the Contractor demonstrate compliance with any requirement in that section if there is evidence that prior tests have been invalidated by the Contractor's change of Supplier or change in manufacturing process. Such demonstration shall be by actual test, or by supplying a report of a previously performed test on similar or like components and configuration. Any additional testing shall be recorded on appropriate test forms provided by the Contractor and shall be conducted before acceptance of the bus.

QA 3.2.1 Visual and Measured Inspections

Visual and measured inspections shall be conducted with the bus in a static condition. The purpose of the inspection testing includes verification of overall dimension and weight requirements, that required components are included and are ready for operation, and that components and subsystems designed to operate with the bus in a static condition do function as designed.

QA 3.2.2 Total Bus Operation

Total bus operation shall be evaluated during road tests. The purpose of the road tests is to observe and verify the operation of the bus as a system and to verify the functional operation of the subsystems that can be operated only while the bus is in motion.

Each bus shall be driven for a minimum of fifteen (15) miles during the road tests. If requested, computerized diagnostic printouts showing the performance of each bus shall be produced and provided to the Agency. Observed Defects shall be recorded on the test forms. The bus shall be retested when Defects are corrected and adjustments are made. This process shall continue until Defects or required adjustments are no longer detected.

QA 4. Agency-Specific Requirements

Water Test Description

The roof, roof hatches, front cap, rear cap, sidewalls, passenger windows, driver's windows, destination sign windows, windshields, wheel wells and all doors of all coaches shall be water tested prior to the delivery of each unit to DTPW as follows:

1. The water test shall consist of a series of nozzles which are strategically located around the perimeter of the vehicle so as to spray water over the entire surface of the vehicle.

2. The nozzles shall eject a volume of water no less than 2.6 gallons per minute per nozzle under a pressure of no less than 22 lbs. per minute measured at the nozzle tip.

3. The contractor shall be required to water test each vehicle under the conditions described above for no less than 30 minutes (15 minutes with A/C off, then 15 minutes with A/C on) to ensure there are no water leaks in the bus.

4. Bus road testing shall be conducted immediately after the water test.

Contractor shall take the necessary steps of corrective action to repair any leaks found as a result of the described test and shall repeat the 30 minute water test to ensure that corrective steps have been successful. This process shall be repeated until no leaks are found. Documentation of each bus shall be kept by the manufacturer as to the location of the leak, what caused the leak to occur and shall describe the repair action taken to prevent the leak from reoccurring.

If the Contractor's bus manufacturing process water test differs from the water test process and criteria described above, then any deviations must be approved by DTPW.

Air Conditioning Test

The Contractor shall conduct a test of the air conditioning system on the first production bus with representatives from DTPW present to verify the performance of the air conditioning system. The air conditioning system must be capable of meeting the performance standards stated in the Air Conditioning, Heating and Ventilation, section of the technical specifications. The contractor shall be responsible for providing the necessary test equipment for this and all other system tests.

The pre-delivery air conditioning test shall be scheduled with sufficient notice to allow the test to be witnessed by the Resident Inspector and other personnel selected by DTPW. Within twelve hours of the completion of the air conditioning test DTPW will notify the contractor if the bus passed the air conditioning test. If the bus fails the test the contractor shall be required to make modifications to all buses as necessary to ensure the buses meet the air conditioning specifications. After the modifications are complete the contractor shall repeat the test with DTPW's representatives present to verify the success of the modifications. No bus may leave the contractor's plant until the first production bus passes the air conditioning test and until the modifications are incorporated into the following buses. DTPW reserves the right to randomly select other production buses for testing of the air conditioning system if it believes the contractor has changed the system or the insulation in the bus.

SPARE PARTS AND EQUIPMENT

SP 1. GENERAL

The Contractor shall guarantee the availability of replacement parts for the acquired buses for at least twelve (12) years after the date of acceptance of the last bus delivered to DTPW. Spare parts shall be interchangeable with the original equipment and shall be manufactured in accordance with the highest quality assurance practices in the industry. Spare parts shall be obtainable through commercial distribution channels to the maximum extent practicable, minimizing captive sole-source distribution practices.

SP 1.1 Recommended Spare Parts List

The Contractor shall prepare and submit to DTPW not less than sixteen (16) weeks prior to delivery of the first bus, a recommended spare and replacement parts list. This listing will become a working document to be used by DTPW in the procurement of spare and replacement parts. The spare and replacement parts list shall group parts by the sub-system of the vehicle system. The listing for each item shall give complete ordering and procurement information for that item. Long lead-time items shall be specifically noted. Each item listing shall contain at least the following information: item name, description, rating, price, manufacturer's name, part number, and drawing reference number. Items that are common to more than one (1) sub-system shall be suitably cross referenced. The Contractor shall recommend the absolute minimum essential quantity of spare parts required to perform normal routine maintenance and to maintain the operation of the fleet assuming standard failure rates of component units. The Contractor shall state the expected failure rate of major components to the extent practicable.

SP1.1.1 Spare Parts, Special Tools and Ancillary Items Provisioning

The Contractor shall include in the Price Proposal pricing for the following spare parts and equipment:

- Spare Wheels - Up to two hundred fifty (250) Spare Wheels (Tire Rims)
- Spare Powertrain up to thirty (30) Powertrains
- Spare Air Conditioning System Parts Sets - up to twenty (20) Sets
- Spare Wheelchair Ramps (Complete Assembly) - up to ten (10) Spare Wheelchair Ramps
- Spare Destination Sign Sets (Complete system) - up to five (5) Spare Destination Sign Sets
- Spare Body Parts Sets - up to ten (10) Sets
- Special tools for powertrain diagnostics and maintenance - up to ten (10) sets
- Special tools for charging station diagnostics and maintenance - up to ten (10) sets
- Special tools for air-conditioning system diagnostics and maintenance - up to ten (10) sets
- Special Tools and Equipment for Cradle or powertrain Changes - up to five (5) Sets
- Multiplexing System Mock-up Board - up to one (1) Mock-up Board

- Universal Tow Bars - up to six (6) Universal Tow Bars

MANUALS AND PUBLICATIONS

MP 1. GENERAL

The Contractor shall provide an electronic copy and fifteen (15) printed current maintenance manual(s) to include preventative maintenance procedures, diagnostic procedures or troubleshooting guides and major component service manuals; an electronic copy and fifteen (15) printed current parts manual(s); and an electronic copy and fifty (50) printed standard operator's manual(s) as part of this Contract. The Contractor also shall exert its best efforts to keep maintenance manuals, operator's manuals and parts books up to date for a period of fifteen (15) years. The supplied manuals shall incorporate all equipment ordered on the buses covered by this procurement. DTPW reserves the right to duplicate, at its expense, all electronic and printed manuals and publications. In instances where copyright restrictions or other considerations prevent the Contractor from incorporating major components information into the bus parts and service manuals, separate manual sets as published by the subcomponent Supplier will be provided.

Draft manuals shall be furnished to DTPW for review and approval no less than sixty (60) days prior to the release of the first bus or commencement of official training, which occurs first.

MP 1.1 Changes and Revisions

Following the publication of each manual required herein, the Contractor shall provide revisions covering any changes, whether required by change of design or procedures or due to error, and these revisions shall be kept current during the entire basic warranty period. Manual revisions shall be furnished to DTPW before or coincidental with the arrival of any altered parts or components. Upon expiration of the basic warranty period, revisions shall be furnished to DTPW, free of charge, as required over the 15 year life of the vehicle.

MP 1.2 Service Bulletins

Service bulletins shall be provided by the Contractor. Updates and revisions shall be provided at no cost to DTPW and shall be provided over 15 year life of the vehicle.

MP 1.3 As Built Drawings

The Contractor shall provide a complete set of "As-Built" drawings in electronic format (AutoCAD or other DTPW approved format) with the delivery of each lot of buses. A complete set of draft "As-Built" drawings shall be furnished to DTPW for review and approval no less than thirty (30) days prior to the delivery of the first bus of each lot of buses. A complete set of final "As-Built" drawings shall be furnished to DTPW no later than sixty (60) days after the delivery of the last bus of each lot of buses.

MP 1.4 Parts Cross Reference List

The Contractor shall furnish a complete bill of materials of all parts/components used in the assembly of the bus. This list shall include as minimum, bus manufacturer's part number, part description, name of original part manufacturer and manufacturer's part/identifying number. The Parts Cross Reference List shall be furnished to DTPW no later than sixty (60) days after the delivery of the last bus of each lot of buses.

ATTACHMENT A: NEW BUS MANUFACTURING INSPECTION GUIDELINES

Pre-production meeting

Responsibilities

Agency

- Provides conformed copy of technical requirements.
- Recommended staff to be involved may include the following:
    - Project manager
    - Technical engineer
    - Contract administrator
    - Quality assurance administrator
    - Warranty administrator
- Process for inspector's role (to deal with agency) for negotiated changes after freeze date.
- Contractual requirements:
    - Milestones
    - Documentation
    - Title requirements
    - Deliverables
    - Payments
    - Reliability tracking

Manufacturer

- Identifies any open issues.
- Recommended staff to be involved may include the following:
    - Project manager
    - Technical engineer(s)
    - Contract administrator
    - Quality assurance administrator
    - Warranty administrator
- Production flow (buses/week, shifts).
- Delivery schedule and offsite component build-up schedule.
- Bus QA documentation (including supplier application approvals and/or any certifications required for the specific production).
- Communication flow/decision making.

Inspector

- Agree on decisions inspectors can and cannot make.
- Primary contact for problems, etc.
- Production flow process (description of manufacturing by station).
- Factory hours (manage inspection schedule based on production hours).
- Plant rules.
- Safety requirements.
- Orientation requirements.
- Work environment.
- Inspector's office space (per contract).

NOTE: As a result of this meeting, documentation should be produced detailing final production requirements and the planned configuration of the bus.

Build schedule

The bus manufacturer's contract administrator shall supply a fleet build production schedule based on the dates in the Notice to Proceed, and a description of the manufacturer's schedule for plant operations.

The production schedule should contain specific milestone dates, such as:

- First vehicle on production line (date on which any work will begin);
- First vehicle off production line;
- First vehicle through manufacturer's quality assurance inspections;
- First vehicle shipped to the agency;
- Last vehicle on production line;
- Last vehicle off production line; and
- Last vehicle shipped to the agency.

Plant tour (if meeting at OEM's location)

The agency will review the entire process from start to finish and review the work completed at each line station, including quality control measures

Prototype/pilot vehicle production

The contractor shall conduct acceptance tests at its plant on each bus following completion of manufacture and before delivery to the agency. These pre-delivery tests shall include visual and measured inspections, as well as testing the total bus operation. The tests shall be conducted and documented in accordance with written test plans approved by the agency. The underfloor equipment shall be available for inspection by the resident inspectors, using a pit or bus hoist provided by the contractor. A hoist, scaffold or elevated platform shall be provided by the contractor to easily and safely inspect bus roofs. Delivery of each bus shall require written authorization of the primary resident inspector. Authorization forms for the release of each bus for delivery shall be provided by the contractor. An executed copy of the authorization shall accompany the delivery of each bus.

Additional tests may be conducted at the agency's discretion to ensure that the completed buses have attained the required quality and have met the requirements in the APTA "Standard Bus Procurement Guidelines RFP," Section 6: Technical Specifications. The agency may, prior to commencement of production, demand that the contractor demonstrate compliance with any requirement in that section if there is evidence that prior tests have been invalidated by the contractor's change of supplier or change in manufacturing process. Such demonstration shall be by actual test, or by supplying a report of a previously performed test on similar or like components and configuration. Any additional testing shall be recorded on appropriate test forms provided by the contractor and shall be conducted before acceptance of the bus.

The pre-delivery tests shall be scheduled and conducted with 30 days' notice so that they may be witnessed by the resident inspectors, who may accept or reject the results of the tests. The results of pre-delivery tests, and any other tests, shall be filed with the assembly inspection records for each bus.

Visual and measured inspections

Visual and measured inspections shall be conducted with the bus in a static condition. The purpose of the inspection testing includes verification of overall dimension and weight requirements, that required components are included and are ready for operation, and that components and subsystems designed to operate with the bus in a static condition do function as designed.

Total bus operation

Total bus operation shall be evaluated during road tests. The purpose of the road tests is to observe and verify the operation of the bus as a system and to verify the functional operation of the subsystems that can be operated only while the bus is in motion.

Each bus shall be driven for a minimum of 15 miles during the road tests. If requested, computerized diagnostic printouts showing the performance of each bus shall be produced and provided to the agency. Observed defects shall be recorded on the test forms. The bus shall be retested when defects are corrected and adjustments are made. This process shall continue until defects or required adjustments are no longer detected.

Post-delivery tests

The agency shall conduct acceptance tests on each delivered bus. These tests shall be completed within 15 days after bus delivery and shall be conducted in accordance with the agency's written test plans. The purpose of these tests is to identify defects that have become apparent between the time of bus release and delivery to the agency. The post-delivery tests shall include visual inspection and bus operations. No post-delivery test shall apply new criteria that are different from criteria applied in a pre-delivery test.

Buses that fail to pass the post-delivery tests are subject to non-acceptance. The agency shall record details of all defects on the appropriate test forms and shall notify the contractor of acceptance or non-acceptance of each bus, after completion of the tests. The defects detected during these tests shall be repaired according to procedures defined in the contract.

Prototype/pilot vehicle acceptance

In order to assess the contractor's compliance with the Technical Specifications, the agency and the contractor shall, at the pre-production meeting, jointly develop a Configuration and Performance Review document for review of the pilot vehicle. This document shall become part of the official record of the pre-production meeting.

Potential dimensional/performance tests that may be included in the Configuration and Performance Review include the following:

- Complete electrical system audit
- Dimensional requirements audit
- Seating capacity
- Water test
- Water runoff test
- Function test of systems/subsystems and components
- Sound/noise level tests
- Vehicle top speed
- Acceleration tests
- Brake stop tests
- Airflow tests
- PA function tests
- Air/brake system audit
- Individual axle weight
- Standee capacity
- Body deflection tests
- Silent alarm function test
- Interior lighting
- Exterior lighting
- Gradability test
- Kneeling system function
- HVAC pulldown/heat
- Speedometer
- Outside air infiltration (smoke)
- Wheelchair ramps

Buy America audit

A post-delivery Buy America audit is required for federally funded bus procurements (see 49 CFR Part 663 for additional information). The onsite resident inspectors are to monitor the production processes to verify compliance with final assembly requirements identified by the Buy America pre-award audit. This audit is to verify compliance with final assembly requirements and final documentation of Buy America compliance and must be completed prior to title transfer.

> **NOTE:** If there is not a pilot/prototype bus, then the Buy America post-delivery audit should be performed following completion of the first serial production bus. In addition to monitoring of the production processes, the agency must verify compliance that more than 60 percent of the costs of all components are produced in the United States. Finally, the agency must execute the required certificates.

Resident inspection process for serial production

At the discretion of the agency, a decision is made to perform resident inspection using the agency's personnel, a contract inspector, or a combination of both. The decision is based on factors such as the availability of personnel, knowledge/expertise in bus build project management, the size of the bus order, etc.

> **NOTE:** The decision to have the resident inspection performed by agency personnel results in a firm understanding and knowledge of the bus and affords the opportunity to identify parts that will be needed for general maintenance down the road.

Inspector responsibilities

The resident inspection process for the serial production of the buses begins following the completion and acceptance of the prototype or pilot vehicle if required, or according to the serial bus production schedule. Resident inspectors should represent the agency for all build-related issues (quality, conformance, etc.). Resident inspectors can also address contractual type issues but should only do so under the consult of the agency's contracts administrator. Resident inspectors are sent to the manufacturer's facility according to a Resident Inspection Schedule. Typically, one or two inspectors arrive on site at the manufacturing facility about one week prior to actual production to set up the resident inspection process and to begin preliminary quality assurance inspections for items such as power plant build-up and wire harness production, and to inspect incoming parts, fasteners, fluids, etc., that will be used in the production of the buses. During the serial production of the buses, the resident inspectors should monitor the production of each bus, verifying the quality of materials, components, sub-assemblies and manufacturing standards. In addition, the configuration of each vehicle should be audited using the vehicle manufacturer's Build Specification and other documents to ensure contract compliance and uniformity.

Inspector rotation/scheduling

During the resident inspection phase, a single inspector or multiple inspectors could be used. If it is decided to use multiple inspectors, then the inspectors could be rotated on a biweekly to monthly basis as required. During the rotation of inspectors, a sufficient period of overlap should be provided to guarantee the consistency of the resident inspection process.

Resident inspector orientation

A resident inspector orientation by the bus manufacturer should take place upon the arrival of the initial inspection team. The orientation should include expectations for the use of personal protective equipment (safety shoes, safety glasses, etc.), daily check-in and check-out requirements, lines of communication, use of production documents such as speed memos and line movement charts, inspector/production meetings, inspector office arrangements, and anything else pertinent to the inspection team's involvement during the build. Many of the above items should already be formalized during the pre-production meeting.

Audits, inspections and tests

The resident inspection process monitors the production of each vehicle. Inspection stations should be strategically placed to test or inspect components or other installations before they are concealed by subsequent fabrication or assembly operations. These locations typically are placed for the inspection of underbody structure, body framing, electrical panels and harnesses, air and hydraulic line routings, installation of insulation, power plant build-up and installation, rust inhibitor/undercoating application, floor installation, front suspension alignment, and other critical areas.

Vehicle inspections

Each bus is subjected to a series of inspections after the bus reaches the point of final completion on the assembly line. Typically, the vehicle manufacturer performs its own quality assurance inspections following assembly line completion before releasing each bus to the resident inspectors. The inspections for each vehicle are documented, signed off upon passing and included in the vehicle record.

These are the typical inspections performed on each bus by the resident inspectors:

- Water test inspection
- Road test inspection
- Interior inspection (including functionality)
- Hoist/undercarriage inspection
- Exterior inspection (including roof)
- Electrical inspection
- Wheelchair ramp/lift inspection

Water test inspection

The water test inspection checks the integrity of the vehicle's body seams, window frame seals and other exterior component close-outs for their ability to keep rainwater, road splash, melting snow and slush, and other exterior water from entering the inside of the vehicle. The vehicle's interior is inspected for signs of moisture and water leaks. To perform the leak inspection, interior ceiling and side panels are removed, and access doors are opened. If any moisture or water is detected, then the source of the leak will be located and repaired by the manufacturer, and the vehicle will be tested again.

Road test inspection

The road test inspection checks all the vehicle's systems and sub-systems while the vehicle is in operation. Typically, the road test inspection is performed immediately following the water test inspection to reveal any standing water that may be present due to a leak, but was not noticed during the "static" water test. Objectionable vibrations, air leakage and other factors that affect ride quality are recorded and reported to the vehicle manufacturer for resolution. Vehicle stability, performance, braking and interlock systems, HVAC, and other critical areas are checked to ensure that the vehicle is complete and ready to provide safe and reliable service.

The following tests may be performed and recorded during the road test:

- Acceleration test
- Top speed test
- Gradability test
- Service brake test
- Parking brake test
- Turning effort test
- Turning radius test
- Shift quality
- Quality of retarder or regenerative braking action

During the road test, a vehicle may be taken to a weigh station to record the vehicle's front axle weight, rear axle weight and total vehicle (curb) weight.

Interior inspection

The interior inspection checks the fit and finish of the interior installations.

In addition, the inspection also verifies the installation and function of systems and subsystems according to the Build Specification. All systems and functions accessed from the interior are inspected for functionality, appearance and safety.

Examples of systems/functions inspected include the following:

- Interior and exterior lighting controls
- Front and rear door systems
- Flooring installation
- Passenger and operator's seat systems
- Wheelchair securement and ramp systems
- Fire suppression system
- Electrical installations (multiplex, tell-tale wiring, panels, etc.)
- Window systems and emergency escape portals
- Operator dash/side panel controls/indicators

Hoist/undercarriage inspection

The hoist/undercarriage inspection checks the installation of components, wiring, air lines, presence of fluid leaks, etc., located under the vehicle. Typically, this inspection is performed following the road test. The vehicle is lifted onto a hoist or pulled over a pit for the inspection. Areas inspected are the front suspension, air bags, air line routings, electrical connections and routings, drive-train components, linkages, and any other system or component that may be prone to early failure due to inadequate installation techniques. All lines, cables, hoses, etc., are inspected for proper securement and protection to prevent rubbing, chafing or any other condition that could result in a failure. The engine/powerplant and HVAC compartments are also inspected during this time.

Exterior inspection

The exterior inspection checks the fit and finish of components installed on the exterior of the vehicle. Access panels are opened and accessories are inspected for proper installation. In addition, vehicle paint, graphics and proper decals are also inspected. Acceptable paint finish quality (orange peel, adhesion, etc.) should be agreed on with the vehicle manufacturer prior to production to ensure consistency of inspections.

Electrical inspection

The vehicle's main electrical panels and other sub-panels are inspected for proper components, to include relays, fuses, modules, terminal strips, decals, etc. In addition, electrical harnesses are inspected for proper wiring and termination techniques, bulkhead protection, looming and other items that could result in future electrical failure. Onboard vehicle compartment schematics are verified for accuracy.

Wheelchair ramp inspection

The wheelchair ramp assembly is inspected for proper installation and performance. Clearances critical to the operation of the ramp are verified, and the ramp's electrical systems are inspected to ensure appropriate wire routings and protection. The successful integration of the ramp assembly into the vehicle is verified, and the vehicle interlocks are checked during automatic and manual ramp operation.

Audits

During serial production of the bus's quality assurance inspection, tests may be performed to ensure that the manufacturer's quality standards are being followed. These inspection audits could be on items such as torque wrench calibrations, proper techniques for fastener installations, proper use and type of adhesives, use of correct installation drawings on the production line, etc.

Communications

The lines of communications, formal and informal, should be discussed and outlined in the pre-production meeting. As previously discussed, resident inspectors should represent the agency for all bus-build related issues (quality, conformance, etc.). Resident inspectors can relay communications addressing contractual type issues but should do so only under the consult of the agency's contracts administrator. Actual personnel contacts for the manufacturing facility should be established during resident inspector orientation. These

contacts could include quality assurance, production, material handling, engineering, and buy-off area personnel.

Documentation

The following documents/reports are typically generated during the bus build process:

- Vehicle Build Specification
- Sales Order
- Pre-production meeting notes
- Prototype and production correspondence (vehicle build file)
- Manufacturer's Vehicle Record (Warranty file)
    - Vehicle line documents
    - Serialization documents (Warranty file)
    - Alignment verification
    - Brake testing
    - HVAC testing and checkout
    - Manufacturer's QA checklist and signoff
- Weight Slip (Prototype & Warranty file)
- Prototype Performance Tests document (vehicle build file)
    - Acceleration Test
    - Top Speed Test
    - Gradability Test
    - Interior Noise Test A – Stationary
    - Interior Noise Test B – Dynamic
    - Exterior Noise Test A – Pull Away
    - Exterior Noise Test B – Pass-By
    - Exterior Noise Test C – Curb Idle
    - Turning Radius Test
    - Turning Effort Test
    - Parking Brake Test
    - Service Brake Test
- Vehicle Acceptance Inspections – Production (Warranty file)
    - Water Test Inspection Report
    - Road Test Inspection Report
    - Interior Inspection Report
    - Hoist/Undercarriage Inspection Report
    - Exterior Inspection Report
    - Electrical Inspection Report
    - Wheelchair Inspection Report
- Speed Memos (Warranty file)
- Agency Vehicle Inspection record (Warranty file)
- Release for Delivery documentation (Warranty file)
- Post-Production Acceptance – Certificate of Acceptance (Accounting)
- Post-Delivery Inspection Report – (Fleet Management & Warranty files)

Vehicle release for delivery

Upon satisfactory completion of all inspection, audit and test criteria, and resolution of any outstanding issues affecting the purchase of any or all buses, proper documentation (the Release for Delivery) is signed by the designated resident inspector authorizing the bus manufacturer to deliver the vehicle to the agency's facility, where it will undergo a post-delivery inspection process and final acceptance. The satisfactory sign-off of the Release for Delivery should complete the resident inspector's duties for each bus. In final preparation for delivery, the bus manufacturer may request the resident inspector to do a final walk-through of the bus after it has been cleaned and prepped for shipping.

Post-delivery and final acceptance

The agency shall conduct acceptance tests on each delivered bus. These tests shall be completed within 15 days after bus delivery and shall be conducted in accordance with the agency's written test plans. The purpose of these tests is to identify defects that have become apparent between the time of bus release and delivery to the agency. The post-delivery tests shall include visual inspection, along with a verification of system(s) functionality and overall bus operations. No post-delivery test shall apply new criteria that are different from criteria applied in a pre-delivery test.

Buses that fail to pass the post-delivery tests are subject to non-acceptance. The agency shall record details of all defects on the appropriate test forms and shall notify the contractor of acceptance or non-acceptance of each bus within five days after completion of the tests. The defects detected during these tests shall be repaired according to procedures defined in the contract after non-acceptance.

Certificate of Acceptance

- **Accepted**
- **Not accepted:** In the event that the bus does not meet all requirements for acceptance. The agency must identify reasons for non-acceptance and work with the OEM to develop a timeline of addressing the problem for a satisfactory resolution and redelivery.
- **Conditional acceptance:** In the event that the bus does not meet all requirements for acceptance, the agency may conditionally accept the bus and place it into revenue service pending receipt of contractor furnished materials and/or labor necessary to address the identified issue(s).

CER 1. Vehicle Technical Information Questionnaire

EXHIBIT 1 – Vehicle Technical Information Questionnaire

The following questionnaire is required to be furnished with the technical proposal.

A. BUS MANUFACTURER_____
Bus Model_____

B. UNDERSTRUCTURE MANUFACTURER_____
Model Number _____

C. BASIC BODY CONSTRUCTION

1. Type _____

2. Tubing or frame member Thickness & Dimensions
   a. Overstructure _____
   b. Understructure _____

3. Skin Thickness and Material
   a. Roof _____
   b. Sidewall _____
   c. Skirt Panel _____
   d. Front End _____
   e. Rear End _____

D. DIMENSIONS

1. Overall Length
   a. Over Bumpers _____Ft. _____In.
   b. Over Body _____Ft. _____In.

2. Overall Width
   a. Over Body excluding Mirrors _____In.
   b. Over Body including Mirrors - driving position _____In.
   c. Over Tires Front Axles _____In.
   d. Over Tires Rear Axles _____In.

3. Overall Height
   a. Over all Height (maximum) _____In.
   b. Overall Height (main roof line) _____In.

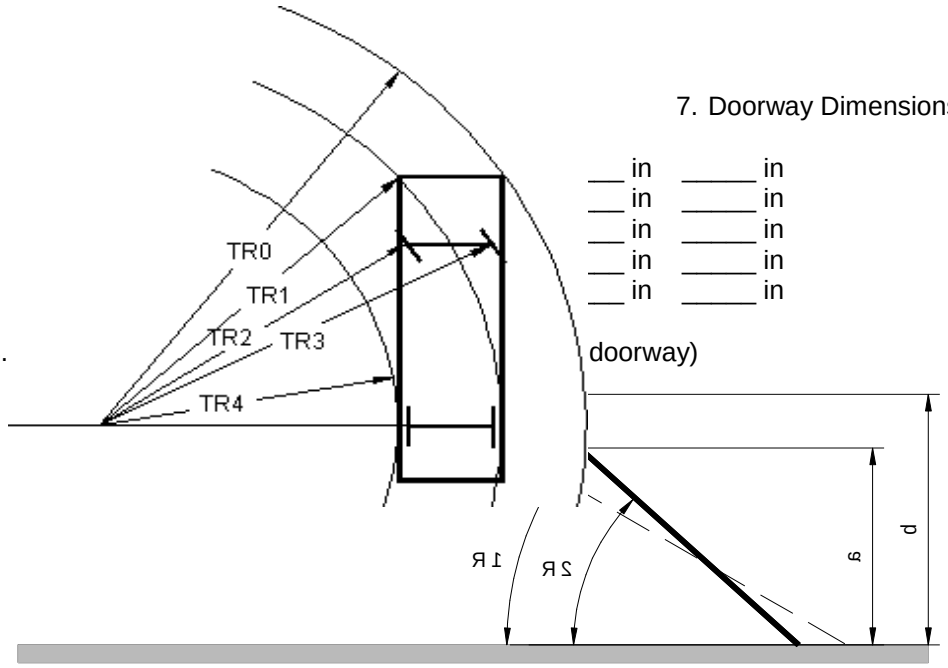
4. Angle of Approach _____Deg.

5. Breakover Angle
   a. Front _____Deg.
   b. Rear (60’ only) _____Deg.

6. Angle of Departure _____Deg.

7. Doorway Dimensions

	Front	Center
	___ in	_____ in
	___ in	_____ in
	___ in	_____ in
	___ in	_____ in
	___ in	_____ in

8. 

	Front Doorway, Empty	Center Doorway	Rear Doorway, Empty
(Kneeled)	a. _____inches	a. _____inches	a. _____inches
(Unkneeled)	b. _____inches	b. _____inches	b. _____inches

9. Interior Head Room (center of aisle)
   a. Front Axle Location _____In.
   b. Center Axle Location _____In.
   c. Drive Axle Location _____In.

10. Aisle Width between Transverse Seats (minimum) _____In.

11. Floor Height Above Ground (centerline of bus)
   a. at Front door _____In.
   b. at Front Axle _____In.
   c. at Center Door _____In.
   d. at Center Axle _____In.
   e. at Rear Door _____In.
   f. at Drive Axle _____In.

12. Minimum Ground Clearance (between bus and ground, with bus unkneeled)
   a. Excluding Axles _____In.
   b. Including Axles _____In.

13. Horizontal Turning Envelope (see diagram below)
   a. Outside Body Turning Radius, TR0 (including bumper) _____Ft. _____In.
   b. Front Inner Corner Radius, TR1 _____Ft. _____In.
   c. Front Wheel Inner Turning Radius, TR2 _____Ft. _____In.
   d. Front Wheel Outer Turning Radius, TR3 _____Ft. _____In.
   e. Inside Body Turning Radius, TR4 (including bumper) _____Ft. _____In

14. Wheelbase _____In.

15. Overhang, Centerline of Axle Over Bumper
    a. Front _____Ft. _____In.
    b. Rear _____Ft. _____In.

16. Floor
    a. Interior Length _____Ft. _____In.
    b. Interior Width (excluding coving) _____Ft. _____In.
    c. Total Standee Area _____Sq. Ft.
    d. Minimum distance between Wheelhouses:
        Front: _____In.
        Center: _____In.
        Rear: _____In.
    e. Maximum interior floor slope
        (from horizontal) _____Deg.

17. Passenger Capacity Provided
    a. Total Maximum Seating _____
    b. Free Floor Space _____sqft.
        (Free floor Space calculation and drawing shall be attached with this form)
    c. Standee Capacity _____
        (Standee Capacity calculation shall be attached with this form)
    d. Minimum Knee to Hip Room _____In.
    e. Minimum Foot Room _____In.

E. WEIGHT OF BUS

	No. of People	Front Axle Left	Front Axle Right	Front Axle Total	Center Axle Left	Center Axle Right	Center Axle Total	Rear Axle Left	Rear Axle Right	Rear Axle Total	Total Bus
Empty Bus Full Fuel and Farebox	0										
Fully Seated Full Fuel and	_____ + Driver										

Farebox											
Fully Loaded Standee and Fully Seated Full Fuel and Farebox	_____ + Driver										
Crush Load (1.5xFully Loaded)	_____										
GVWR											
GAWR											

F. POWER TRAIN

1. Manufacturer _____
2. Motor Type _____
2. Max Power _____
4. Max Torque _____
5. Battery Type _____
6. Battery Capacity _____
7. Charging Capacity _____
8. Charging Time _____
9. Range _____
10. Transmission _____

G. AIR COMPRESSOR

1. Manufacturer & Model No._____
2. Type _____
3. Rated Capacity _____cfm

4. Frequency _____Hz

H. AXLE, FRONT

1. Manufacturer _____

2. Type _____

3. Model Number _____

4. Gross Axle Weight Rating _____lbs.

5. Axle Load _____lbs.

I. AXLE, REAR

1. Manufacturer _____

2. Type _____

3. Model Number _____

4. Gross Axle Weight Rating _____lbs.

5. Axle Load _____lbs.

6. Axle Ratio _____

J. SUSPENSION SYSTEM

1. Manufacturer _____
2. Type: Front _____
   Rear _____
3. Springs: Front _____
   Rear _____

K WHEELS AND TIRES

1. Wheels
   a. Manufacturer _____
   b. Size _____
   c. Capacity _____lbs.
   d. Material _____

2. Tires
   a. Manufacturer _____
   b. Type _____
   c. Size _____
   d. Load Range/Air Press. _____lbs/p.s.i
   e Speed Rating _____
   f. Load Index _____

3. Lug Nut Torque Specifications
   a. Front Axle _____ft lbs

b. Center Axle _____ft lbs
c. Rear Axle _____ft lbs

L. STEERING, POWER

1. Pump
   a. Manufacturer & Model No. _____
   b. Type _____
   c. Relief Pressure _____psi

2. Booster/Gear Box
   a. Manufacturer & Model No. _____
   b. Type _____
   c. Ratio _____
   d. Relief Pressure _____psi

2. Power Steering Fluid Capacity _____gals

4. Maximum Effort at Steering Wheel _____lbs.
   (unloaded stationary coach on dry asphalt pavement)

5. Steering Wheel Diameter _____in.

M. BRAKES

1. Manufacturer of Fundamental Brake System _____

2. Brake Chambers Manufacturer, Size, & Part No.
   a. Front _____
   b. Center _____
   c. Rear _____

3. Brake Operation Effort _____

4. Slack Adjuster's Vendor's Type & Part No.
   a. Front
      1) Right _____
      2) Left _____

   b. Rear
      1) Right _____
      2) Left _____

   d. Length
      1) Front Take-up _____In.
      2) Center Take-up _____In.
      3) Rear Take-up _____In.

5. Brake Drums/Discs
   a. Front
      1) Manufacturer _____
      2) Part Number _____
      _____

3) Diameter _____in.

b. Rear
1) Manufacturer _____
2) Part Number _____
_____
3) Diameter _____in.

6. Brake Lining Manufacturer _____
Type _____

1. Brake Lining Identification

a. Front
1) Forward _____
2) Reverse _____

b. Rear
1) Forward _____
2) Reverse _____

8. Brake Linings Per shoe
a. Front _____
b. Rear _____

9. Brake Lining Widths
a. Front _____In.
b. Rear _____In

10. Brake Lining Lengths
a. Front _____In.
b. Rear _____In.

11. Brake Lining Thickness _____In.

12. Brake Lining Area Per Axle
a. Front _____Sq. In.
b. Rear _____Sq. In.

N. AIR RESERVOIR CAPACITY

1. Supply Reservoir _____Cu. In.

2. Primary Reservoir _____Cu. In.

3. Secondary Reservoir _____Cu. In.

4. Parking Reservoir _____Cu. In.

5. Accessory Reservoir _____Cu. In.

6. Other Reservoir Type _____Cu. In.

7. Air Reservoir Total Capacity _____Cu. In

O. HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

1. Manufacturer _____

2. Model _____

3. Type _____

4. Refrigerant Type _____
   a. Refrigerant Capacity _____Lbs

5. Electric Power Requirements _____

6. Physical Description
   a. Weight _____Lbs
   b. Construction _____
   c. Height _____
   d. Width _____
   e. Length _____

7. Heating System Capacity _____B.T.U.

8. Air Conditioning Capacity _____B.T.U.

9. Ventilating Capacity _____cfm

10. Compressor
    a. Manufacturer _____
    b. Model _____
    c. No. of Cylinders _____
    d. Drive Ratio _____
    e. Maximum Warranted Speed _____r.p.m.
    f. Operating Speed _____r.p.m.
    g. Weight _____lbs.
    h. Oil Capacity
       1) Dry _____gals.
       2) Wet _____gals.
    i. Refrigerant _____Type _____Lbs.

11. Condenser
    a. Manufacturer _____
    b. Model _____
    c. No. of Rows _____
    d. No. of Fins/In. _____
    e. O.D. of Tube _____In.
    f. Fin Thickness _____In.

12. Condenser Fan
    a. Manufacturer _____
    b. Model _____
    c. Fan Diameter _____In.
    d. Speed Maximum _____RPM
    e. Flow Rate (maximum) _____CFM

13. Receiver
    a. Manufacturer _____
    b. Model _____
    c. Capacity _____Lbs

14. Condenser Fan Drive Motors
    a. Manufacturer _____
    b. Model _____
    c. Type _____
    d. Horse Power _____HP
    e. Operating Speed _____ r.p.m.

15. Evaporator Fan Drive Motors
    a. Manufacturer _____
    b. Model _____
    c. Type _____
    d. Horse Power _____HP
    e. Operating Speed _____r.p.m.

16. Evaporator(s)
    a. Manufacturer _____
    b. Model _____
    c. Number of Rows _____
    d. No. of Fins/In. _____
    e. Outer Diameter of Tube _____In.
    f. Fin Thickness _____In.
    g. Number of Evaporator _____

17. Expansion Valve
    a. Manufacturer _____
    b. Model _____

18. Filter-Drier
    a. Manufacturer _____
    b. Model _____

19. Heater Cores
    a. Manufacturer _____
    b. Model _____
    c. Capacity _____B.T.U.
    d. Number of Rows _____
    e. Number of Fins/In. _____
    f. Outer Diameter of Tube _____In.
    g. Fin Thickness _____In.
    h. Number of Heater Cores _____

20. Controls
    a. Manufacturer _____

b. Model _____
c. Type _____

21. Driver's Heater
    a. Manufacturer _____
    b. Model No. _____
    c. Capacity _____B.T.U.

22. Ventilation System
    a. Type _____

23. Generator
    a. Type _____
    b. Rated Speed (maximum) _____
    c. Drive Mechanism _____
    d. Voltage _____
    e. Capacity _____

P. PASSENGER INTERIOR LIGHTING

1. Manufacturer _____

2. Type _____

3. Number of Fixtures _____

4. Size of Fixtures _____

5. Power Pack _____

Q. DOORS

1. Front
    a. Manufacturer of Operating Equipment _____
    b. Type of Door _____
    c. Type of Operating Equipment _____

2. Rear
    a. Manufacturer of Operating Equipment _____
    b. Type door _____
    c. Type of Operating Equipment _____

R. PASSENGER WINDOWS

1. Manufacturer _____

2. Model _____

3. Type _____

4. Number: (Side) _____
(Rear) _____

5. Sizes: _____ _____ _____

6. Glazing:
   a. Type _____
   b. Thickness _____
   c. Color of Tint _____
   d. Light Transmission _____

S. MIRRORS

	Size	Type	Manufacturer	Mfg. Part #	Model No.
Right Side Exterior	____	____	_____	_____	_____
Left Side Exterior	____	____	_____	_____	_____
Center Rearview		____	____	_____	_____	_____
Front Entrance Area	____	____	_____	_____	_____
Upper-Right Hand Corner		____	____	_____	_____	_____
Rear Exit Area		____	____	_____	_____	_____

T. SEATS
1. Manufacturer _____
2. Model _____
3. Type _____

U. PAINT
1. Manufacturer _____
2. Type _____

V. WHEELCHAIR RAMP EQUIPMENT

1. Manufacturer & Model No. _____

2. Type _____

3. Capacity _____Lbs.

4. Dimensions
   a. Width of Platform _____In.
   b. Length of Platform _____In.

5. System Fluid Capacity _____Qts.

6. Type Fluid Used _____

7. Operating Hydraulic Pressure _____

8. Hydraulic Cylinders _____psi
   a. Size _____
   b. Number _____

W WHEELCHAIR SECUREMENT EQUIPMENT

1. Manufacturer _____
2. Model No. _____

X. DESTINATION SIGNS

1. Manufacturer _____

2. Type _____

3. Character Length
   a. Front Destination _____ In.
   b. Front Run Number _____ In.
   c. Side Destination _____ In.
   d. Rear Route _____ In.

4. Character Height
   a. Front Destination _____ In.
   b. Front Run Number _____ In.
   c. Side Destination _____ In.
   d. Rear Route _____ In.

5. Number of Characters
   a. Front Destination _____ In.
   b. Front Run Number _____ In.
   c. Side Destination _____ In.
   d. Rear Route _____ In.

6. Message Width
   a. Front Destination _____ In.
   b. Front Run Number _____ In.
   c. Side Destination _____ In.
   d. Rear Route _____ In.

Y. ELECTRICAL

1. Multiplex System
   a. Manufacturer _____
   b. Model No. _____

2. Batteries
   a. Manufacturer _____
   b. Model No. _____
   c. Type _____
   d. CCA _____
   e. Number of batteries _____

Z. COMMUNICATION SYSTEM

1. GPS
   a. Manufacturer _____
   b. Model No. _____

3. P.A. System

	Manufacturer	Model No.
a. Amplifier	_____	_____
b. Microphone	_____	_____
c. Int. Speakers	_____	_____ (number ___)

d. Ext. Speaker _____ _____ (number ___)

AA. CCTV SYSTEM

1. DVR Manufacturer _____

2. Model No. _____

3. Cameras - Manufacture/Model

1_____/_____
2_____/_____
3_____/_____
4_____/_____
5_____/_____
6_____/_____
7_____/_____
8_____/_____
9_____/_____
10_____/_____
11_____/_____
12_____/_____

BB. BICYCLE RACK

1. Manufacturer _____

2. Model No. _____

CC. OPERATOR'S SEAT

1. Manufacturer _____

2. Model No. _____

DD. FLOOR COVERING

1. Manufacturer _____

2. Model No. _____

3. Color _____

4. Standee Line Color _____

EE. ROOF VENTILATORS

1. Manufacturer _____
2. Model No. _____
3. Quantity _____
4. Location(s) _____

FF. BUMPER

1. Manufacturer _____

MIAMI-DADE COUNTY DEPARTMENT OF TRANSPORTATION AND PUBLIC WORKS

CERTIFICATION OF COMPLINACE WITH FLORIDA DEPARTMENT OF TRANSPORTATION (FDOT) RULE 14-90.007

The undersigned [Contractor/Manufacturer] certifies that the vehicle offered in this procurement complies with Chapter 341.061(2), Florida Statutes and the current revision of Rule 14-90.007 – Vehicle Equipment Standards and Procurement Criteria, Florida Administrative Code (FAC).

SIGNATURE: _____

PRINT NAME: _____

TITLE: _____

COMPANY: _____

DATE: _____

References

SAE #	Title	Date Published
J10	Methods of Test for Paints - Part J10: Determination of Deposition Efficiency of Coating Powders	Sep 15, 1998
J211	Instrumentation for Impact Test—Part 2: Photographic Instrumentation	May 1, 2001
J287	Driver Hand Control Reach	Feb 1, 2007
J366	Exterior Sound Level for Heavy Trucks and Buses	Feb 1, 1987
J382	Windshield Defrosting Systems Performance Requirements - Trucks, Buses, and Multipurpose Vehicles.	Jan 1, 1994
J534	Lubrication Fittings	May 1, 2008
J537	Storage Batteries	Sep 1, 2000
J541	Voltage Drop for Starting Motor Circuits	Oct 1, 1996
J587	License Plate Illumination Devices (Rear Registration Plate Illumination Devices)	Sep 1, 2003
J593	Backup Lamps (Reversing Lamps)	Sep 1, 2005
J673	Automotive Safety Glasses	Oct 1, 2005
J680	Location and Operation of Instruments and Controls in Motor Truck Cabs, Recommended Practice	Sep 1, 1988
J686	Motor Vehicle License Plates	Oct 1, 1999
J689	Curbstone Clearance, Approach, Departure, and Ramp Breakover Angles—Passenger Car and Light Truck	Aug 1, 2009
J833	Human Physical Dimensions	May 1, 2003
J844	Nonmetallic Air Brake System Tubing	Nov 1, 2004
J941	Motor Vehicle Drivers' Eye Locations	Mar 1, 2010
J994	Alarm—Backup—Electric Laboratory Performance Testing	Mar 1, 2009
J1050	Describing and Measuring the Driver's Field of View	Jan 1, 2003
J1113	Electromagnetic Compatibility Component Test Procedure Part 42, Conducted Transient Emissions	Oct 1, 2006
J1127	Low Voltage Battery Cable	Mar 1, 2010
J1128	Low Voltage Primary Cable	Dec 1, 2005
J1149	Metallic Air Brake System Tubing and Pipe	Aug 1, 2007
J1292	Automobile and Motor Coach Wiring	Jan 1, 2008
J1455	Recommended Environmental Practices for Electronic Equipment Design in Heavy-Duty Vehicle Applications	Jun 1, 2006
J1587	Joint SAE/TMC Electronic Data Interchange between Microcomputer Systems in Heavy-Duty Vehicle Applications, Recommended Practice	Jan 1, 1996
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J1986	Balance Weight and Rim Flange Design Specifications, Test Procedures, and Performance Recommendations	Jan 1, 2006
J1939	Data Link Layer	Dec 1, 2006
J1995	Engine Power Test Code - Spark Ignition and Compression Ignition - Gross Power Rating, Standard;	Jun 1, 1990
J2402	Road Vehicles—Symbols for Controls, Indicators, and Tell-tales	Jan 1, 2010

J2711	Recommended Practice for Measuring Fuel Economy and Emissions of Hybrid-Electric and Conventional Heavy-Duty Vehicles	Sept 1, 2002

Abbreviation and Acronyms

A/C	air conditioning
ABS	anti-lock braking system
AC	alternating current
ACQ	alkaline copper quaternary
ADA	Americans with Disabilities Act
Ah	amp hour
ALR	auto-locking retractor
APA	The Engineered Wood Association, formerly the American Plywood Association
APC	automatic passenger counter
APTA	American Public Transportation Association
ASTM	ASTM International, formerly the American Society for Testing and Materials
ATC	automatic traction control
AVL	automatic vehicle location
AWG	American Wire Gauge
BAFO	Best and Final Offer
BMS	Battery Management System
BRT	bus rapid transit
CARB	California Air Resources Board
CCS	climate control system
CCTV	closed-circuit television
cfm	cubic feet per minute
CGA	Compressed Gas Association
CNG	compressed natural gas
dB	decibel
DBE	disadvantaged business enterprise
DC	direct current
DDU	driver display unit
DEF	diesel exhaust fluid
DOT	Department of Transportation
DPF	diesel particulate filter
ECM	Engine Control and Monitoring
ECS	emission control system
ELR	emergency locking retractor
EMI	electromagnetic interference
EPA	Environmental Protection Agency
ESS	energy storage system
FEA	Finite Element Analysis
FEMA	failure mode effects analysis
FMCSA	Federal Motor Carrier Safety Administration
FMCSR	Federal Motor Carrier Safety Regulations
FMVSS	Federal Motor Vehicle Safety Standards
FTA	Federal Transit Administration
GAWR	gross axle weight rated
GPS	global positioning system
GVW	gross vehicle weight
GVWR	gross vehicle weight rated
H-point	hip-point
HDS	hybrid drive system
HMI	human-machine interface
HSC	hybrid system controller
HV	high voltage
HVAC	heating, ventilation and air conditioning
I/O	input/output
IEEE	Institute of Electrical and Electronics Engineers

ISO	International Standards Organization
LEL	LED emergency light
LV	low voltage
mA	milliampere
MDT	mobile data terminal
MPa	mega-Pascal
NC	normally closed
NFPA	National Fire Protection Association
NGV	natural gas vehicle
NOx	nitrogen oxide
NO	normally open
NTP	notice to proceed
OEM	original equipment manufacturer
OSI	Open Systems Interconnect
PA	public address
PMO	project management oversight
PPU	primary propulsion unit
PPU	prime power unit
PPV	price per vehicle
PRD	pressure relief device
psi	pounds per square inch
RF	radio frequency
RFI	radio frequency interference
RTC	real-time clock
SAE	SAE International, formerly the Society of Automotive Engineers
scf	standard cubic feet
SLW	seated load weight
SOC	state of change
UL	Underwriters Laboratories
UNECE	United Nations Economic Commission for Europe
VDC	volts of direct current
Wh	watt-hours
VIN	vehicle information number